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# ENGINE

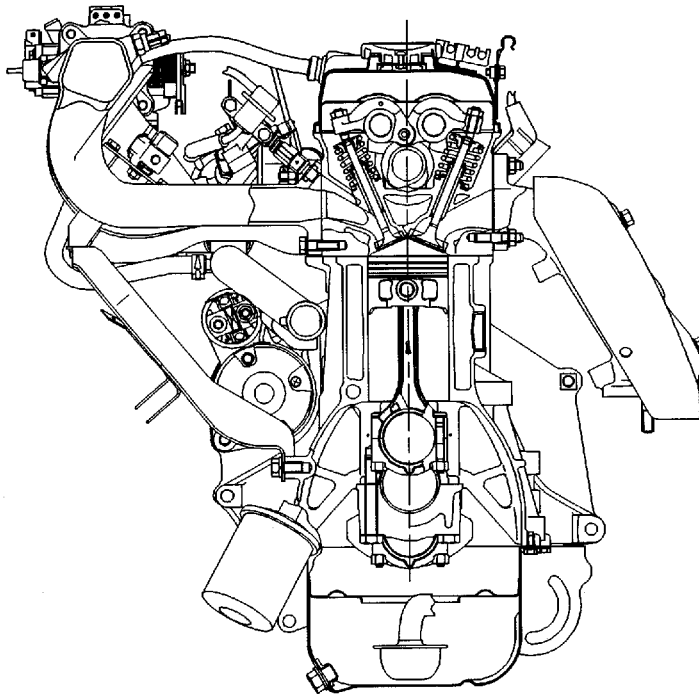
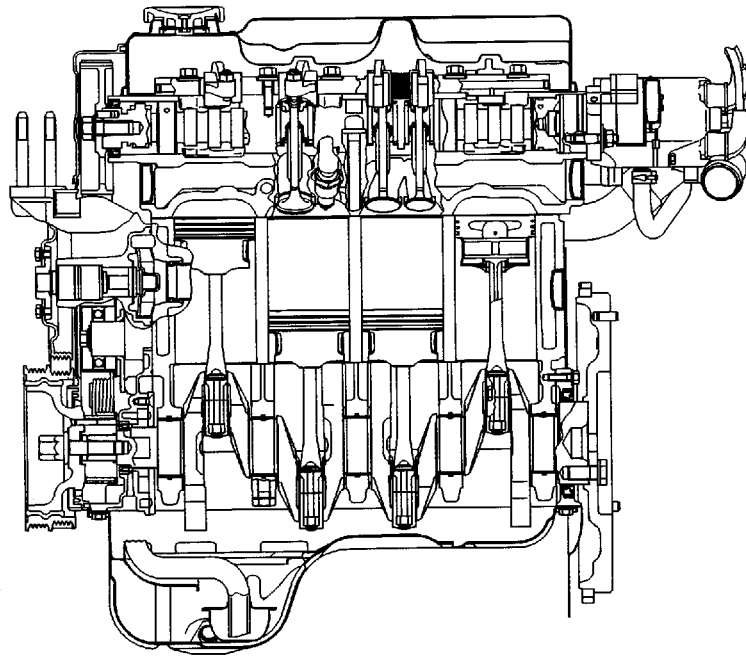
# 4G1 SERIES

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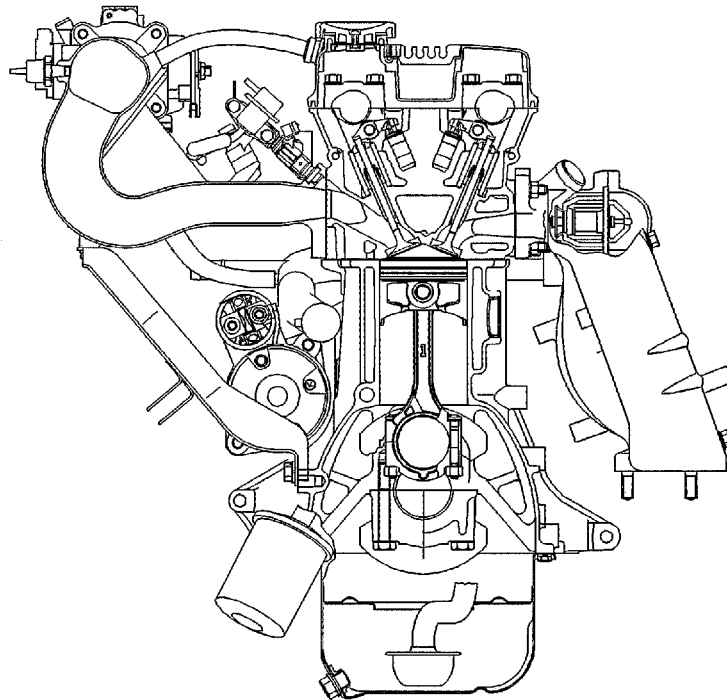
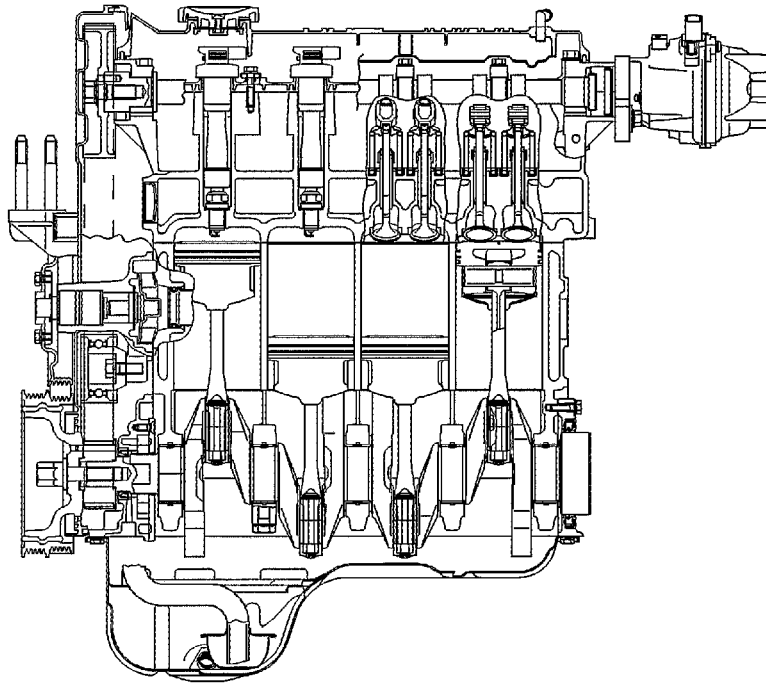
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NOTES

# GENERAL INFORMATION



1EN0524



1EN0416

Descriptions		4G13 12-VALVE-CARBURETOR	4G13 12-VALVE-MPI
Type		In-line OHV, SOHC	In-line OHV, SOHC
Number of cylinders		4	4
Combustion chamber		Pentroof type	Pentroof type
Total displacement dm <sup>3</sup>		1,299	1,299
Cylinder bore mm		71.0	71.0
Piston stroke mm		82.0	82.0
Compression ratio		9.5	9.5
Number of valves	Intake	8	8
	Exhaust	4	4
Valve timing	Intake opens	BTDC 14°	BTDC 19°
	Intake closes	ABDC 48°	ABDC 43°
	Exhaust opens	BBDC 55°	BBDC 60°
	Exhaust closes	ATDC 13°	ATDC 8°
Lubrication system		Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type		Trochoid type	Trochoid type
Cooling system		Water-cooled, forced circulation	Water-cooled, forced circulation
Water pump type		Centrifugal impeller type	Centrifugal impeller type

Descriptions		4G13 16-VALVE-MPI	4G18 16-VALVE-MPI
Type		In-line OHV, SOHC	In-line OHV, SOHC
Number of cylinders		4	4
Combustion chamber		Pentroof type	Pentroof type
Total displacement dm <sup>3</sup>		1,299	1,584
Cylinder bore mm		71.0	76.0
Piston stroke mm		82.0	87.3
Compression ratio		10	9.5
Number of valves	Intake	8	8
	Exhaust	8	8
Valve timing	Intake opens	BTDC 17°	BTDC 17°
	Intake closes	ABDC 39°	ABDC 39°
	Exhaust opens	BBDC 49°	BBDC 49°
	Exhaust closes	ATDC 7°	ATDC 7°
Lubrication system		Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type		Trochoid type	Trochoid type
Cooling system		Water-cooled, forced circulation	Water-cooled, forced circulation
Water pump type		Centrifugal impeller type	Centrifugal impeller type

Descriptions		4G15-CARBURETTOR	4G15-MPI
Type		In-line OHV, SOHC	In-line OHV, DOHC
Number of cylinders		4	4
Combustion chamber		Semi spherical type	Pentroof type
Total displacement dm <sup>3</sup>		1,468	1,468
Cylinder bore mm		75.5	75.5
Piston stroke mm		82.0	82.0
Compression ratio		9.0	9.5
Number of valve	Intake	8	8
	Exhaust	4	8
Valve timing	Intake opens	BTDC 14°	BTDC 16°
	Intake closes	ABDC 48°	ABDC 40°
	Exhaust opens	BBDC 55°	BBDC 45°
	Exhaust closes	ATDC 13°	ATDC 15 °
Lubrication system		Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type		Trochoid type	Trochoid type
Cooling system		Water-cooled, forced circulation	Water-cooled, forced circulation
Water pump type		Centrifugal impeller type	Centrifugal impeller type

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## NOTES



# 1. SPECIFICATIONS

## SERVICE SPECIFICATIONS

Item		Standard	Limit	
<b>Rocker arms, rocker shafts, and camshaft</b>				
Camshaft cam height mm	SOHC 12-VALVE	Intake (primary)	38.78	38.28
		Intake (secondary)	38.78	38.28
		Exhaust	39.10	38.60
	SOHC 16-VALVE	Intake	36.99	36.49
		Exhaust	36.85	36.35
	DOHC	Intake	34.67	38.28
Exhaust		34.26	38.60	
Camshaft journal diameter mm		SOHC	45.93 - 45.94	-
		DOHC	25.95 - 25.97	-
<b>Cylinder head and valves</b>				
Flatness of cylinder head gasket surface mm		0.05 or less	-	
Cylinder head gasket surface grinding limit (including grinding of cylinder block gasket surface) mm		-	0.2	
Cylinder head overall height mm	SOHC 12-VALVE	106.9 - 107.1	-	
	SOHC 16-VALVE	119.9 - 120.1	-	
	DOHC	131.9 - 132.1	-	
Cylinder head bolt nominal length mm		-	103.2	
Valve margin mm	Intake	1.0	0.5	
	Exhaust	1.5	1.0	
Valve stem diameter mm	SOHC 12-VALVE	6.6	-	
	SOHC 16-VALVE	5.5	-	
	DOHC	5.5	-	
Valve stem-to-guide clearance mm	SOHC 12-VALVE	Intake	0.020 - 0.050	0.10
		Exhaust	0.050 - 0.085	0.15
	SOHC 16-VALVE	Intake	0.020 - 0.047	0.10
		Exhaust	0.030 - 0.062	0.15
	DOHC	Intake	0.020 - 0.047	0.10
		Exhaust	0.030 - 0.062	0.15
Valve face angle		45° - 45.5°	-	
Valve stem projection mm	SOHC 12-VALVE	Intake	43.70	44.20
		Exhaust	43.30	43.80
	SOHC 16-VALVE	Intake	53.21	53.71
		Exhaust	54.10	54.60
	DOHC	Intake	48.80	49.30
		Exhaust	48.70	49.20

Item			Standard	Limit
Overall valve length mm	SOHC 12-VALVE	Intake	100.75	100.25
		Exhaust	101.05	105.55
	SOHC 16-VALVE	Intake	111.56	111.06
		Exhaust	114.71	114.21
	DOHC	Intake	106.35	105.85
		Exhaust	106.85	106.35
Valve spring free height mm	SOHC 12-VALVE	Intake	46.1	45.6
		Exhaust	46.8	46.3
	SOHC 16-VALVE		50.9	50.4
	DOHC		49.1	48.6
Valve spring load/ installed height N/ mm	SOHC 12-VALVE	Intake	226/40.0	-
		Exhaust	284/39.6	-
	SOHC 16-VALVE		216/44.2	-
	DOHC		177/40.0	-
Valve spring squareness			2°	4°
Valve seat contact width mm			0.9 - 1.3	-
Valve guide internal diameter mm	SOHC 12-VALVE		6.6	-
	SOHC 16-VALVE		5.5	-
	DOHC		5.5	-
Valve guide projection mm	SOHC 12-VALVE		17.0	-
	SOHC 16-VALVE		23.0	-
	DOHC		23.0	-
<b>Oil pump and oil pan</b>				
Oil pump tip clearance mm			0.06 - 0.18	-
Oil pump side clearance mm			0.04 - 0.10	-
Oil pump body clearance mm			0.10 - 0.18	0.35
<b>Pistons and connecting rods</b>				
Piston outside diameter mm	4G13		71.0	-
	4G15		75.5	-
	4G18		76.0	-
Piston ring side clearance mm	No. 1 ring		0.02 - 0.06	-
	No. 2 ring		0.02 - 0.06	-
Piston ring end gap clearance	No. 1 ring		0.20 - 0.35	0.8
	No. 2 ring		0.35 - 0.50	0.8
	Oil ring		0.20 - 0.50	1.0
Piston pin O. D. mm			18.0	-
Piston pin press-in load (at room temperature) N			4,900 - 14,700	-
Crankshaft pin oil clearance mm			0.02 - 0.04	0.1
Connecting rod big end side clearance mm			0.10 - 0.25	0.4

Item		Standard	Limit
<b>Crankshaft and cylinder block</b>			
Crankshaft end play mm		0.05 - 0.18	0.25
Crankshaft journal diameter mm		48.0	-
Crankshaft pin diameter mm		42.0	-
Crankshaft journal oil clearance mm		0.02 - 0.04	0.1
Cylinder block gasket surface flatness mm		0.05 or less	-
Cylinder block gasket surface grinding limit (including grinding of cylinder head gasket surface) mm		-	0.2
Cylinder block overall height mm		256	-
Cylinder block cylindricity mm		0.01	-
Cylinder block I. D. mm	4G13	71.0	-
	4G15	75.5	-
	4G18	76.0	-
Piston-to-cylinder clearance mm		0.02 - 0.04	-

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## REWORK DIMENSIONS

Item		Standard	Limit		
<b>Cylinder head and valves</b>					
Cylinder head oversize valve guide hole diameter mm	SOHC 12-VALVE	0.05 O. S.	12.050 - 12.068	-	
		0.25 O. S.	12.250 - 12.268	-	
		0.50 O. S.	12.500 - 12.518	-	
	SOHC 16-VALVE	0.05 O. S.	10.550 - 10.568	-	
		0.25 O. S.	10.750 - 10.768	-	
		0.50 O. S.	11.000 - 11.018	-	
	DOHC	0.05 O. S.	10.550 - 10.568	-	
		0.25 O. S.	10.750 - 10.768	-	
		0.50 O. S.	11.000 - 11.018	-	
Oversize valve seat ring hole diameter mm	SOHC 12-VALVE	Intake (primary)	0.3 O. S.	27.300 - 27.325	-
			0.6 O. S.	27.600 - 27.625	-
		Intake (secondary)	0.3 O. S.	32.300 - 32.325	-
			0.6 O. S.	32.600 - 32.625	-
		Exhaust	0.3 O. S.	35.300 - 35.325	-
			0.6 O. S.	35.600 - 35.625	-
	SOHC 16-VALVE <4G13>	Intake	0.3 O. S.	28.300 - 28.321	-
			0.6 O. S.	28.600 - 28.621	-
		Exhaust	0.3 O. S.	26.300 - 26.321	-
			0.6 O. S.	26.600 - 26.621	-
	SOHC 16-VALVE <4G18>	Intake	0.3 O. S.	30.300 - 30.321	-
			0.6 O. S.	30.600 - 30.621	-
		Exhaust	0.3 O. S.	28.300 - 28.321	-
			0.6 O. S.	28.600 - 28.621	-
	DOHC	Intake	0.3 O. S.	31.300 - 31.325	-
			0.6 O. S.	31.600 - 31.625	-
Exhaust		0.3 O. S.	27.800 - 27.825	-	
		0.6 O. S.	28.100 - 28.125	-	

## TORQUE SPECIFICATIONS

Item		Nm
<b>Alternator and ignition system</b>		
Water pump pulley bolt		9
Alternator brace (alternator side)		22
Alternator brace (tightened with water pump)		23
Alternator pivot bolt		44
Oil level gauge guide		23
Crankshaft bolt		125
Spark plug		25
Distributor		11
Ignition coil		10
Camshaft position sensor		9
Camshaft position sensor support		13
Camshaft position sensing cylinder		21
<b>Timing belt</b>		
Timing belt cover		11
Timing belt tensioner		23
Crankshaft angle sensor (Rear wheel drive)		9
Engine support bracket (left)		35
Idler pulley		35
Camshaft sprocket bolt		88
<b>Fuel system</b>		
Delivery pipe		11
Fuel pressure regulator		9
Throttle body		18
Fuel pump		11
Breather tube		22
Carburetor		17
Air temperature sensor		13
EGR valve		21
<b>Water pump</b>		
Water inlet fitting		22
Water inlet pipe assembly		12
Water inlet pipe	M6	12
	M8	25
Fitting (Rear wheel drive)		23
Water outlet fitting (Rear wheel drive)		23
Thermostat case		23

Item	Nm	
Thermo valve	27	
Water temperature gauge unit	11	
Water temperature sensor	29	
Water pump	13	
<b>Exhaust manifold and intake manifold</b>		
Boost sensor	5	
Solenoid valve assembly	9	
Intake manifold	17	
Intake manifold stay (MPI)	M8	17
	M10	21
Intake manifold stay (carburetor)	29	
Exhaust manifold cover	29	
Exhaust manifold	M8	17
	M10	29
Oxygen sensor	44	
<b>Rocker arms, rocker shafts, and camshaft</b>		
Fuel pump cover	12	
Rocker cover	4	
Rocker shaft assembly	31	
Adjusting screw	15	
Bearing cap	24	
	11	
<b>Cylinder head and valves</b>		
Cylinder head bolt Tighten to 49 Nm, then completely loosen and retighten as described.	20 + 90° + 90°	
<b>Oil pump and oil pan</b>		
Transmission stay	23	
Oil pan	7	
Drain plug	39	
Oil screen	18	
Front case	13	
Relief plug	44	
Oil pump cover	10	
<b>Pistons and connecting rods</b>		
Connecting rod nut	17 + 90° to 100°	

Item	Nm
<b>Crankshaft and cylinder block</b>	
Flywheel	132
Drive plate	132
Rear plate	10
Bell housing cover	10
Rear oil seal case	11
Bearing cap bolt	51
Oil pressure switch	18
Knock sensor	23



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**NEW TIGHTENING METHOD USING PLASTIC REGION TIGHTENING BOLTS**

Parts of the engine use plastic region tightening bolts. The tightening procedure for these is different from that of conventional bolts and is described in relevant parts of this manual. Note that plastic region tightening bolts have fixed service limits. These limits are indicated in relevant parts of this manual and must be strictly observed.

- Plastic region tightening bolts are used for the following applications:
  - (1) Cylinder head bolts
  - (2) Connecting rod cap bolts
- The tightening procedure is basically as follows:  
 After tightening a bolt to the specified torque, tighten it by a further  $90^\circ + 90^\circ$  or by a further 90–100°. The exact tightening procedure differs depending on the bolt and is described in relevant parts of this manual.

**SEALANTS**

Item	Specified sealant	Quantity
Water pump	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Thermo valve	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Engine coolant temperature sensor	3M Nut Locking Part No. 4171 or equivalent	As required
Engine coolant temperature gauge unit	3M ATD Part No. 8660 or equivalent	As required
Camshaft bearing cap	3M ATD Part No. 8660 or equivalent	As required
Semi-circular packing	3M ATD Part No. 8660 or equivalent	As required
Rocker cover	3M ATD Part No. 8660 or equivalent	As required
Front oil seal case	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Oil pump	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Oil pressure switch	3M ATD Part No. 8660 or equivalent	As required

## FORM-IN-PLACE GASKET

The engine has several areas where the form-in-place gasket (FIPG) is in use. To ensure that the gasket fully serves its purpose, it is necessary to observe some precautions when applying the gasket. Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of the fluid feed line. To eliminate the possibility of leaks from a joint, therefore, it is absolutely necessary to apply the gasket evenly without a break, while observing the correct bead size.

The FIPG used in the engine is a room temperature vulcanization (RTV) type and is supplied in a 100-gram tube (Part No. MD970389 or MD997110). Since the RTV hardens as it reacts with the moisture in the atmospheric air, it is normally used in the metallic flange areas. The FIPG, Part No. MD970389, can be used for sealing both engine oil and coolant, while Part No. 997110 can only be used for engine oil sealing.

### Disassembly

The parts assembled with the FIPG can be easily disassembled without use of a special method. In some cases, however, the sealant between the joined surfaces may have to be broken by lightly striking with a mallet or similar tool. A flat and thin gasket scraper may be lightly hammered in between the joined surfaces. In this case, however, care must be taken to prevent damage to the joined surfaces. For removal of the oil pan, the special tool "Oil Pan Remover" (MD998727) is available. Be sure to use the special tool to remove the oil pan. <Except aluminium die-cast oil pans>

### Surface Preparation

Thoroughly remove all substances deposited on the gasket application surfaces, using a gasket scraper or wire brush. Check to ensure that the surfaces to which the FIPG is to be applied is flat. Make sure that there are no oils, greases and foreign substances deposited on the application surfaces. Do not forget to remove the old sealant remained in the bolt holes.

### Form-In-Place Gasket Application

When assembling parts with the FIPG, you must observe some precautions, but the procedure is very simple as in the case of a conventional pre-cut gasket.

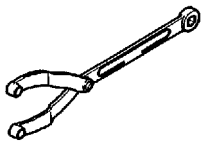
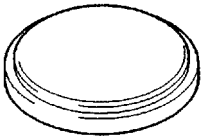
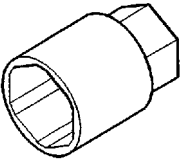
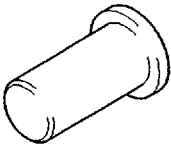
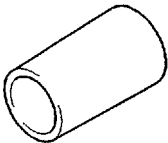

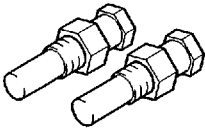
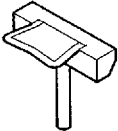
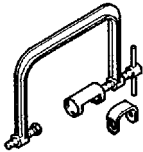
Applied FIPG bead should be of the specified size and without breaks. Also be sure to encircle the bolt hole circumference with a completely continuous bead. The FIPG can be wiped away unless it is hardened. While the FIPG is still moist (in less than 15 minutes), mount the parts in position. When the parts are mounted, make sure that the gasket is applied to the required area only. In addition, do not apply any oil or water to the sealing locations or start the engine until a sufficient amount of time (about one hour) has passed after installation is completed.

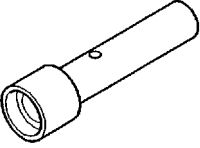
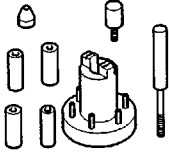

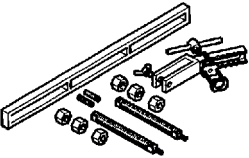
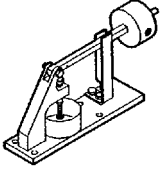
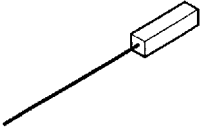
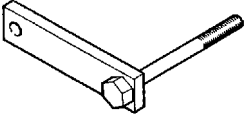
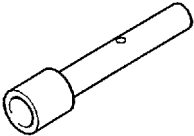
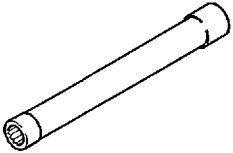
The FIPG application procedure may vary on different areas. Observe the procedure described in the text when applying the FIPG.

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## NOTES

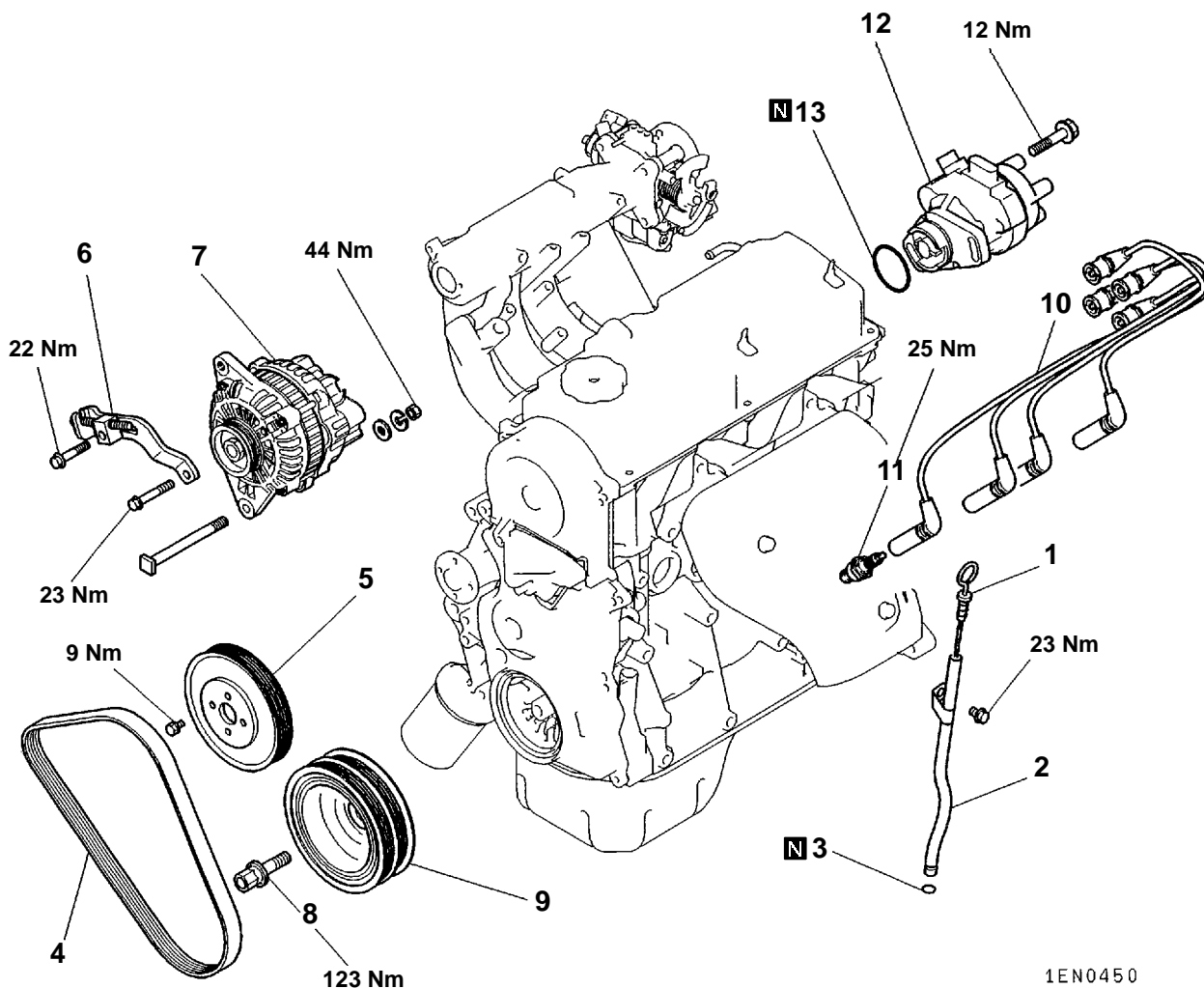
## 2. SPECIAL TOOLS

Tool	Number	Name	Use
	MB990767	End yoke holder	Holding camshaft sprocket when loosening or tightening bolt (used with MD998715)
	MD998011	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal
	MD998054	Oil pressure switch wrench	Removal and installation of oil pressure switch
	MD998304	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998305	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal
	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998715	Pin (2-off)	Holding camshaft sprocket when loosening or tightening bolt (used with MB990767)
	MD998727	Oil pan remover	Removal of oil pan
	MD998735	Valve spring compressor	Compression of valve springs

Tool	Number	Name	Use
	MD998760	Valve stem seal installer	Installation of valve stem seals (SOHC 12-VALVE)
	MD998780	Piston pin setting tool	Removal and press-fitting of piston pins
	MB991659	Guide-D	Guide for removal and press-fitting of piston pins
	MD998772	Valve spring compressor	Compression of valve springs
	MD998440	Leak-down tester	Testing of automatic lash adjusters (DOHC)
	MD998442	Air bleed wire	Testing of automatic lash adjusters (DOHC)
	MD998781	Flywheel stopper	Locking flywheel in fixed position
	MB991671	Valve stem installer	Press-fitting of valve stem seals (SOHC 16-VALVE, DOHC)
	MB991653	Cylinder head bolt wrench (10)	Removal and installation of cylinder head bolt

### 3. ALTERNATOR AND IGNITION SYSTEM

#### REMOVAL AND INSTALLATION <SOHC 12-VALVE>



1EN0450

#### Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Drive belt\*
5. Water pump pulley
6. Alternator brace
7. Alternator
8. Crankshaft bolt
9. Crankshaft pulley

10. Spark plug cable
11. Spark plug
12. Distributor
13. O-ring

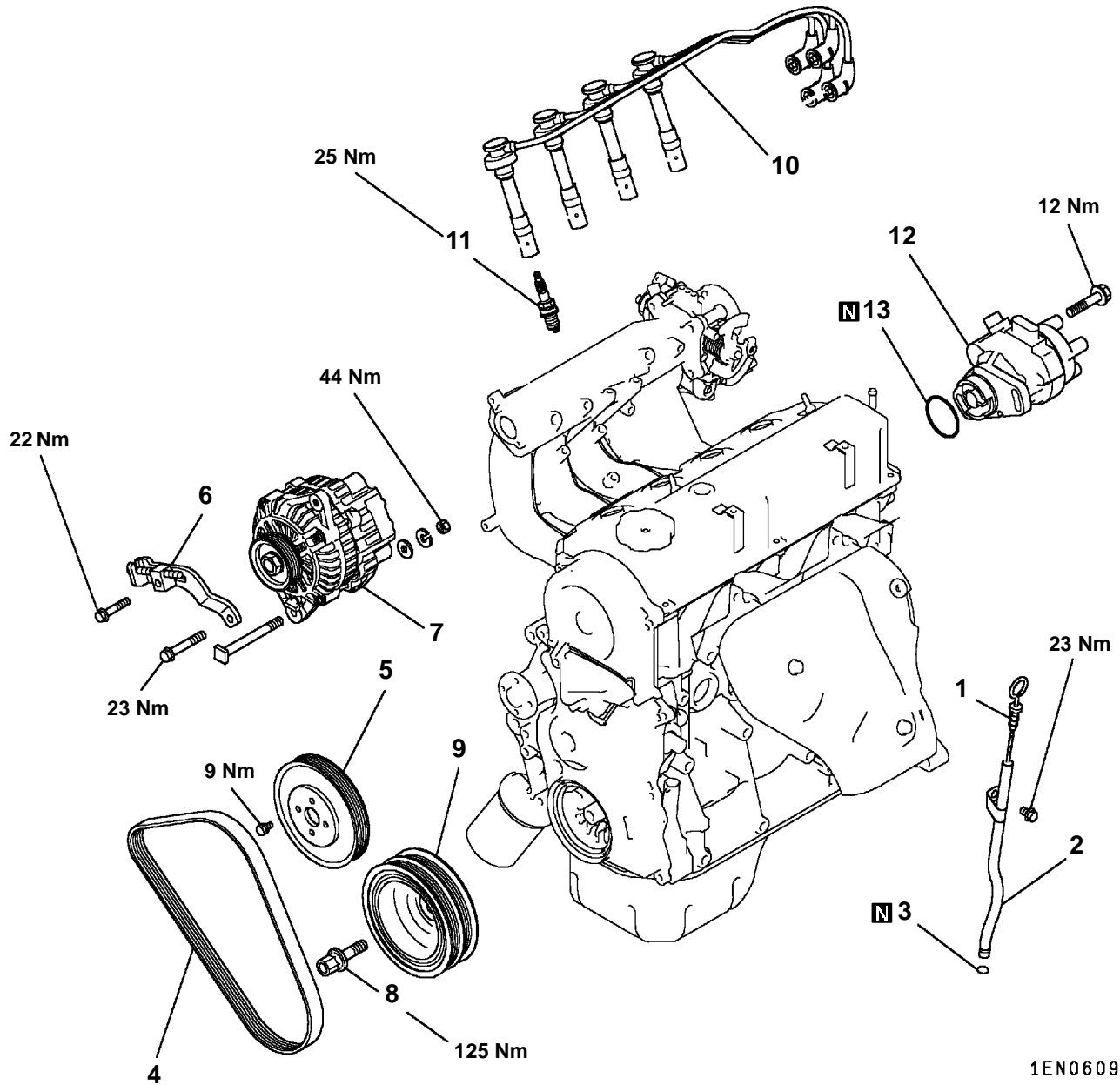


#### NOTE

\*: For details of adjustment, refer to the relevant model's chassis workshop manual.



REMOVAL AND INSTALLATION <SOHC 16-VALVE-FRONT WHEEL DRIVE>



1EN0609

Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Drive belt\*
5. Water pump pulley
6. Alternator brace
7. Alternator
8. Crankshaft bolt
9. Crankshaft pulley



10. Spark plug cable
11. Spark plug
12. Distributor
13. O-ring

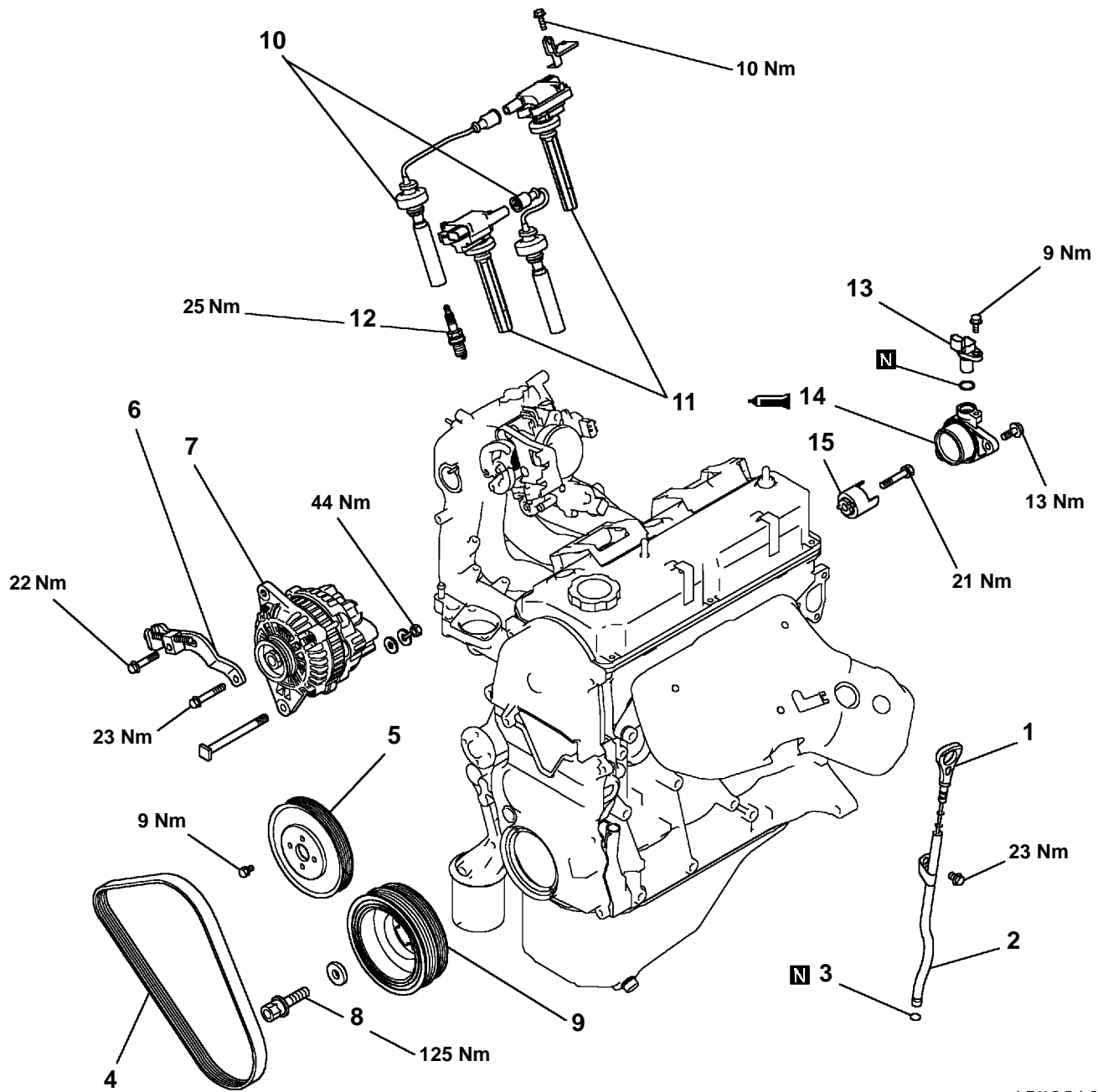


NOTE

\*: For details of adjustment, refer to the relevant model's chassis workshop manual.



REMOVAL AND INSTALLATION <SOHC 16-VALVE-REAR WHEEL DRIVE>



1EN0610

**Removal steps**

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Drive belt\*
5. Water pump pulley
6. Alternator brace
7. Alternator
8. Crankshaft bolt
9. Crankshaft pulley

10. Spark plug cable
11. Ignition coil
12. Spark plug
13. Cam position sensor
14. Cam position sensor support
15. Cam position sensing cylinder

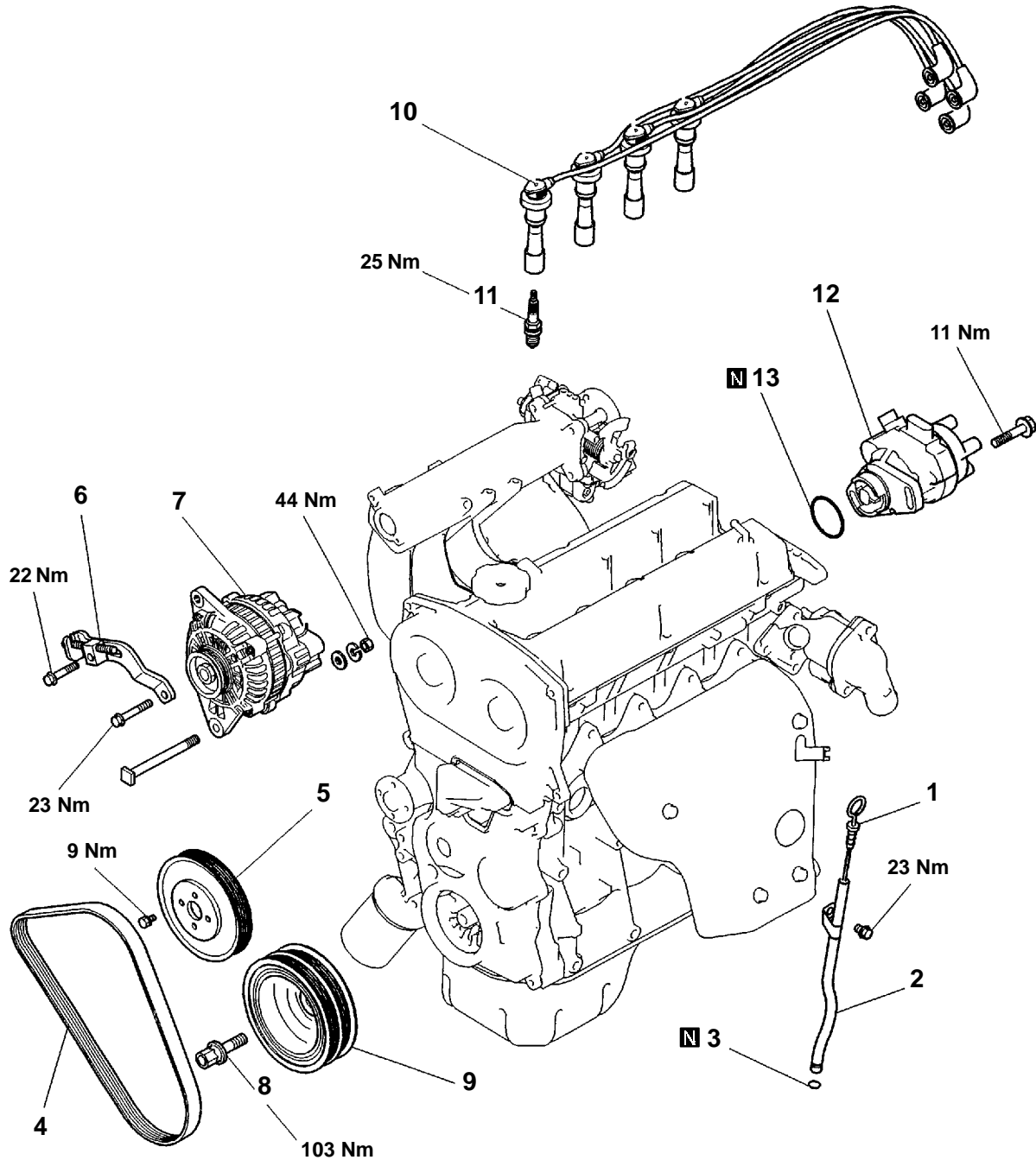
◀A▶ ▶B▶

▶C▶

**NOTE**

\*: For details of adjustment, refer to the relevant model's chassis workshop manual.

REMOVAL AND INSTALLATION <DOHC>



1EN0451

Removal steps

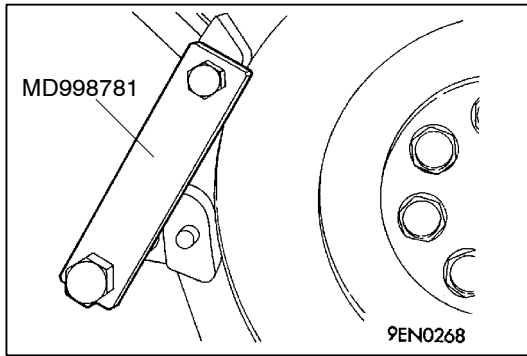
1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Drive belt\*
5. Water pump pulley
6. Alternator brace
7. Alternator
8. Crankshaft bolt
9. Crankshaft pulley



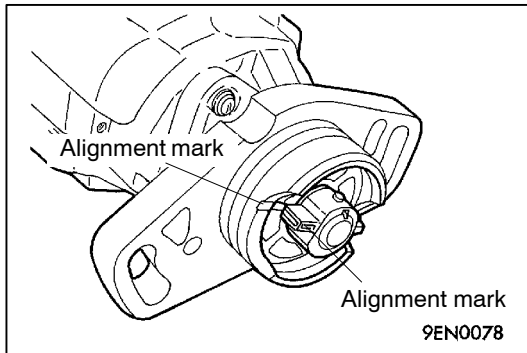
10. Spark plug cable
11. Spark plug
12. Distributor
13. O-ring

NOTE

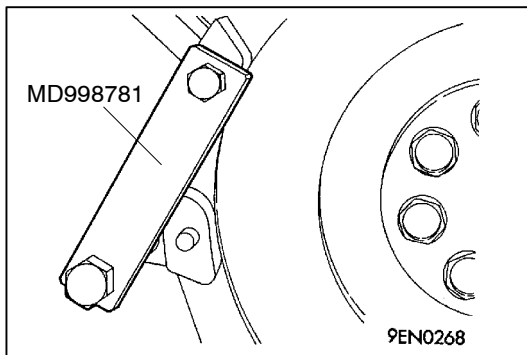
\*: For details of adjustment, refer to the relevant model's chassis workshop manual.

**REMOVAL SERVICE POINT****◀A▶ CRANKSHAFT BOLT REMOVAL**

- (1) Lock the flywheel or drive plate in position using the special tool shown in the illustration, then loosen the crankshaft bolts.

**INSTALLATION SERVICE POINTS****▶A◀ DISTRIBUTOR INSTALLATION**

- (1) Turn the crankshaft clockwise until cylinder No. 1 is at top dead center on its compression stroke.
- (2) Align the alignment marks on the distributor housing and coupling.
- (3) Fit the distributor onto the engine, aligning the stud bolts with the slots in the distributor mounting flange.

**▶B◀ CRANKSHAFT BOLT INSTALLATION**

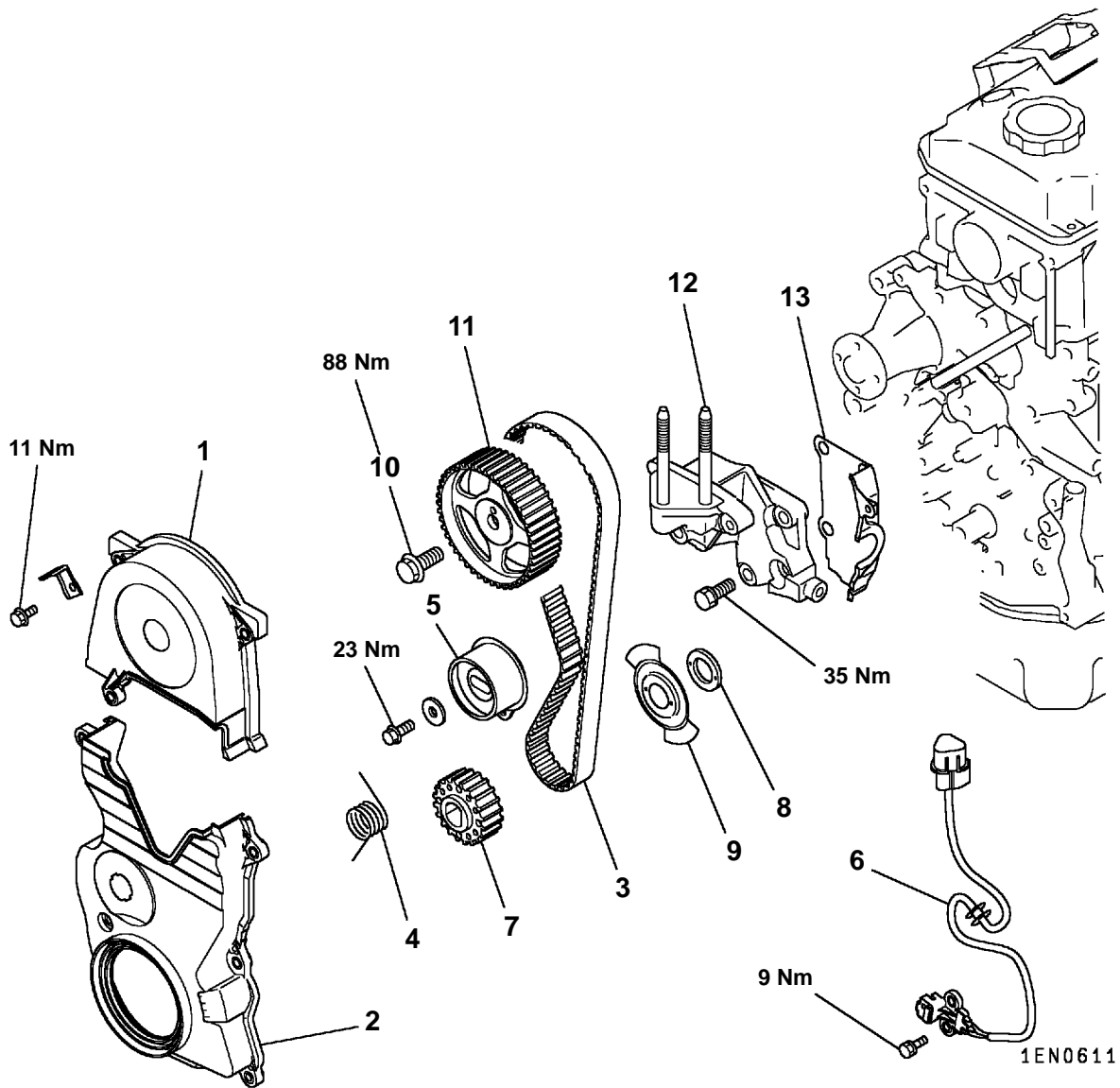
- (1) Lock the flywheel or drive plate in position using the special tool shown in the illustration, then tighten the crankshaft bolts.

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## NOTES

## 4. TIMING BELT

### REMOVAL AND INSTALLATION <SOHC>



#### Removal steps

◀A▶

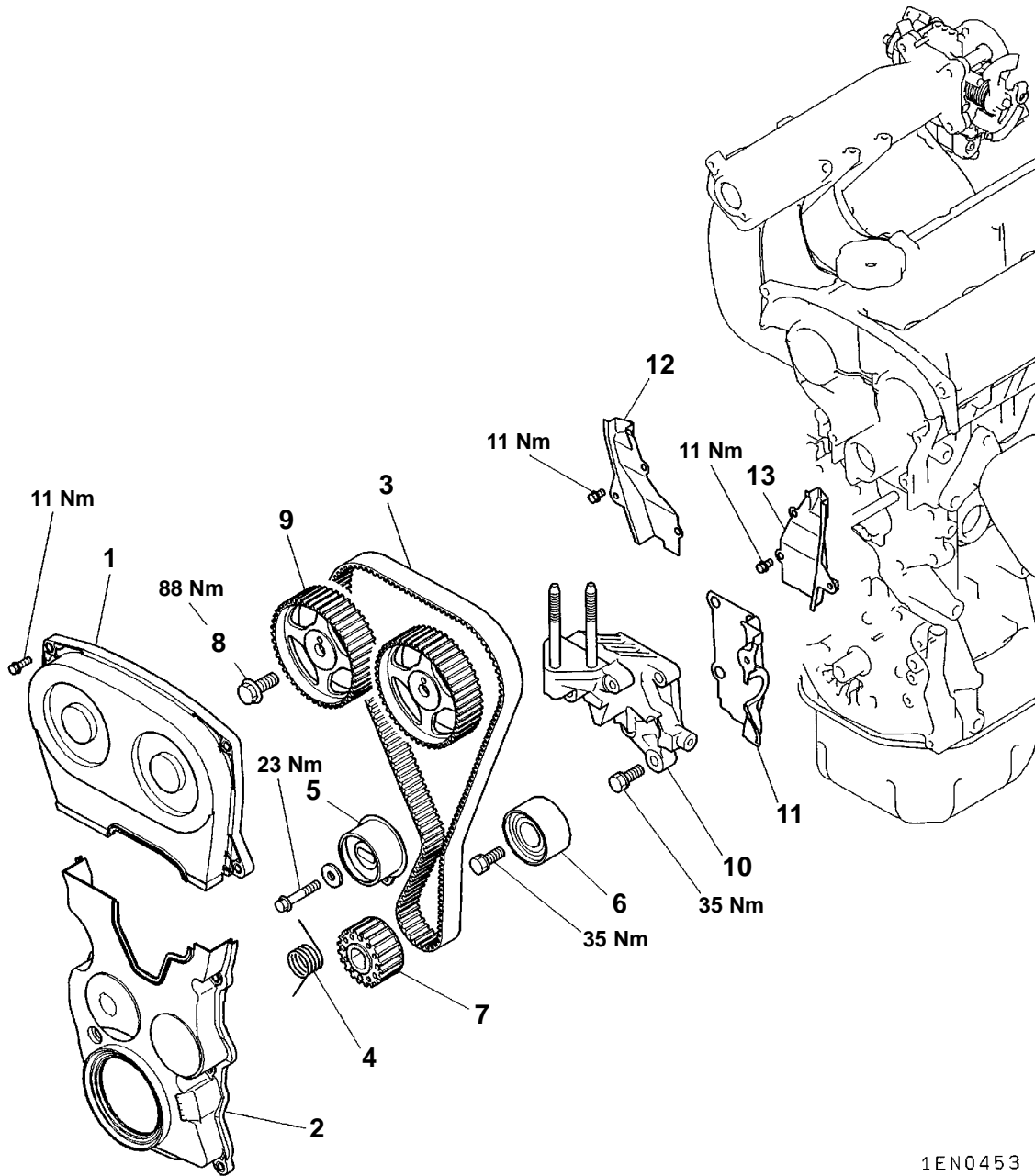
▶C▶  
▶B▶  
▶B▶

1. Timing belt upper cover
2. Timing belt lower cover
3. Timing belt
4. Tensioner spring
5. Timing belt tensioner
6. Crankshaft angle sensor  
<Rear wheel drive>

◀B▶ ▶A▶

7. Crankshaft sprocket
8. Spacer <Rear wheel drive>
9. Sensing blade <Rear wheel drive>
10. Camshaft sprocket bolt
11. Camshaft sprocket
12. Engine support bracket
13. Timing belt rear cover

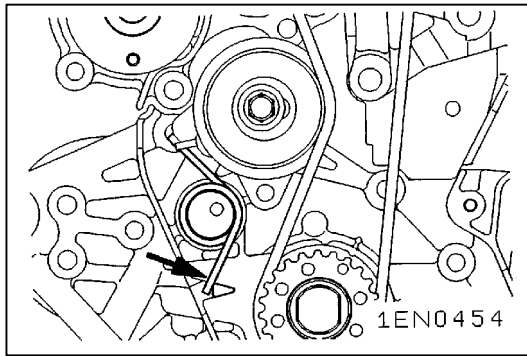
REMOVAL AND INSTALLATION <DOHC>



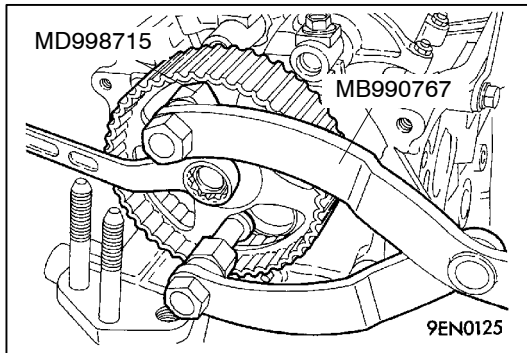
1EN0453

Removal steps

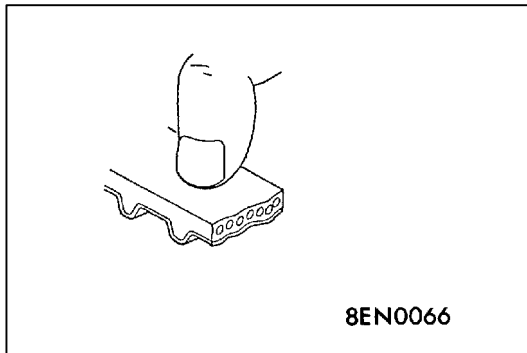
- |         |                            |         |                                    |
|---------|----------------------------|---------|------------------------------------|
| ◀A▶ ▶D▶ | 1. Timing belt upper cover | ◀B▶ ▶A▶ | 8. Camshaft sprocket bolt          |
| ◀A▶ ▶B▶ | 2. Timing belt lower cover |         | 9. Camshaft sprocket               |
| ◀A▶ ▶B▶ | 3. Timing belt             |         | 10. Engine support bracket         |
|         | 4. Tensioner spring        |         | 11. Timing belt rear cover (lower) |
|         | 5. Timing belt tensioner   |         | 12. Timing belt rear cover (right) |
|         | 6. Idler pulley            |         | 13. Timing belt rear cover (left)  |
|         | 7. Crankshaft pulley       |         |                                    |

**REMOVAL SERVICE POINTS****◀A▶ TIMING BELT / TENSIONER SPRING / TIMING BELT TENSIONER REMOVAL**

- (1) Using pliers, grip the tensioner spring projection (marked "A" in the diagram) and remove it from the oil pump case stopper. Then, remove the tensioner spring.
- (2) Remove the timing belt tensioner.
- (3) If the timing belt is to be reused, chalk an arrow on the belt to indicate the direction of rotation before removing it. This will ensure the timing belt is fitted correctly when reused.

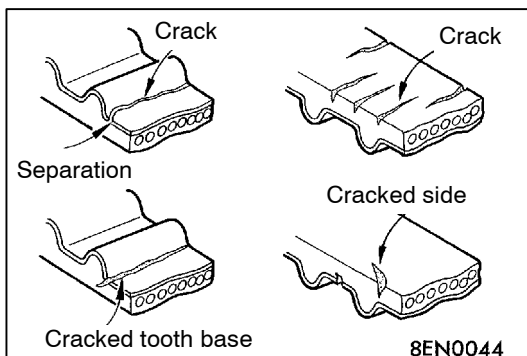
**◀B▶ CAMSHAFT SPROCKET BOLT REMOVAL**

- (1) Using the special tools shown in the illustration, lock the camshaft sprocket in position.
- (2) Loosen the camshaft sprocket bolt.

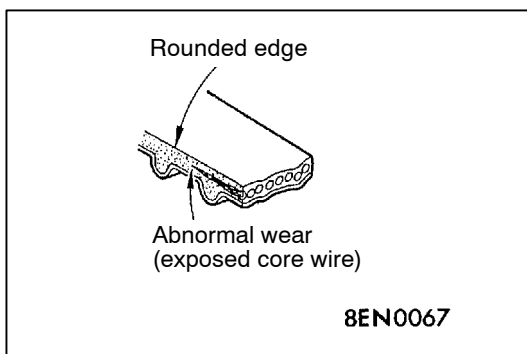
**INSPECTION****1. TIMING BELT**

Check the timing belt closely. Replace the belt with a new one if any of the following defects is evident:

- (1) Hardened backing rubber (the backing rubber is glossy, non-elastic, and so hard that scratching with fingernails leaves no mark)



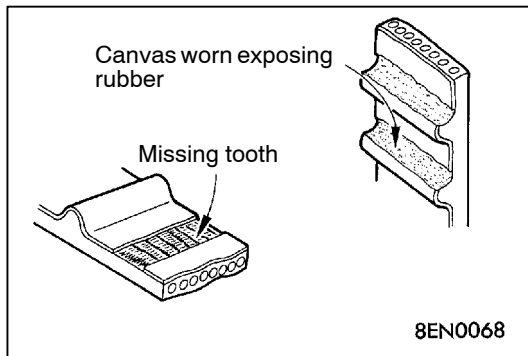
- (2) Surface cracks in the backing rubber
- (3) Splits in the canvas and/or separation of the canvas and rubber
- (4) Cracks at the bases of teeth
- (5) Cracks in the side of the belt



- (6) Abnormal wear on the belt's sides

**NOTE**

The sides of the belt are normal if they are sharp as if cut by a knife.



## (7) Abnormal wear on teeth

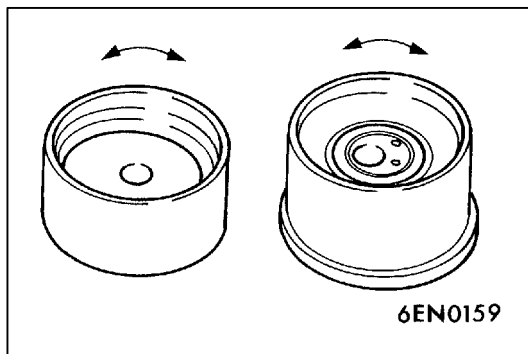
Initial stage:

Canvas worn (fluffy canvas fibers, rubbery texture gone, white discoloration, canvas texture indistinct)

Final stage:

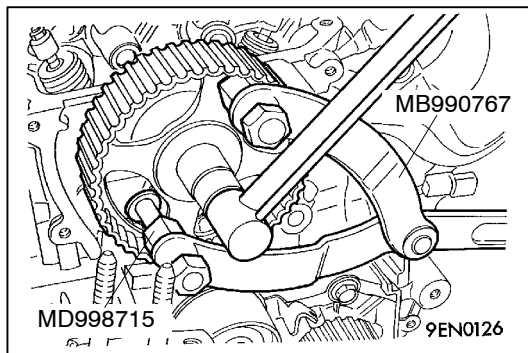
Canvas worn, exposing rubber (tooth width reduced)

## (8) Missing teeth



## 2. TENSIONER PULLEY AND IDLER PULLEY

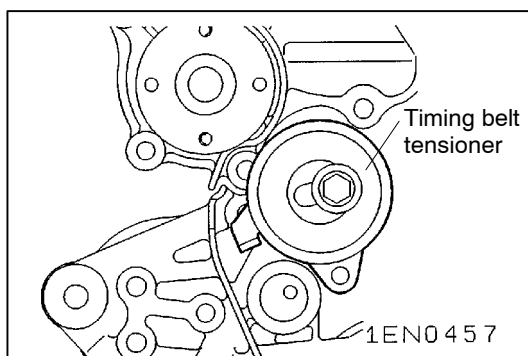
- (1) Check that the pulleys turn smoothly without play and are not abnormally noisy. Replace either or both of the pulleys if necessary.



## INSTALLATION SERVICE POINTS

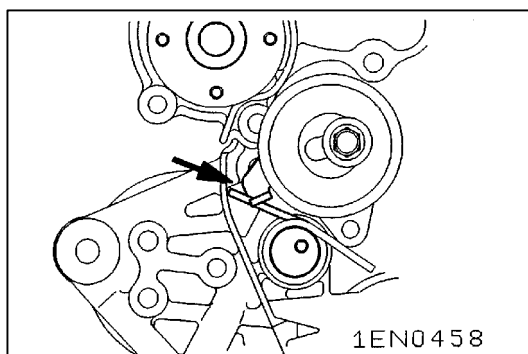
## ▶A◀ CAMSHAFT SPROCKET BOLT INSTALLATION

- (1) Using the special tools shown in the illustration, lock the camshaft sprocket in position.
- (2) Tighten the camshaft sprocket bolt to the specified torque.



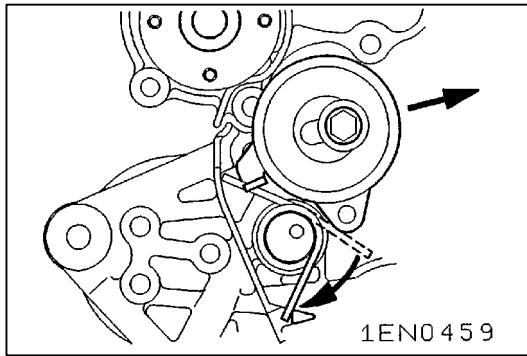
## ▶B◀ TIMING BELT TENSIONER / TENSIONER SPRING INSTALLATION

- (1) Lock the timing belt tensioner in the illustrated position.

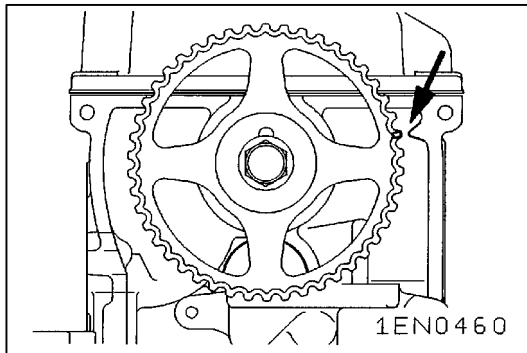


- (2) Fit one of the tensioner spring projections over the hooked portion of the timing belt tensioner and fit the tensioner onto the oil pump case.



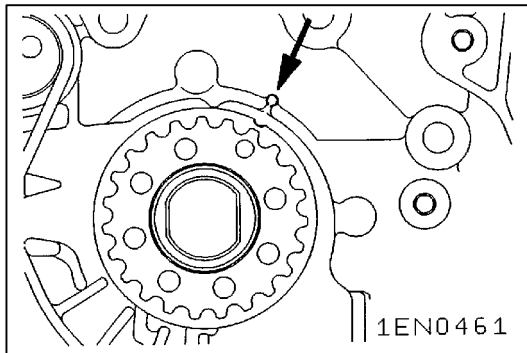


- (3) Grip the other tensioner spring projection and fit it onto the oil pump case lug as shown in the illustration.
- (4) Move the timing belt tensioner in the direction shown and temporarily tighten the bolt.

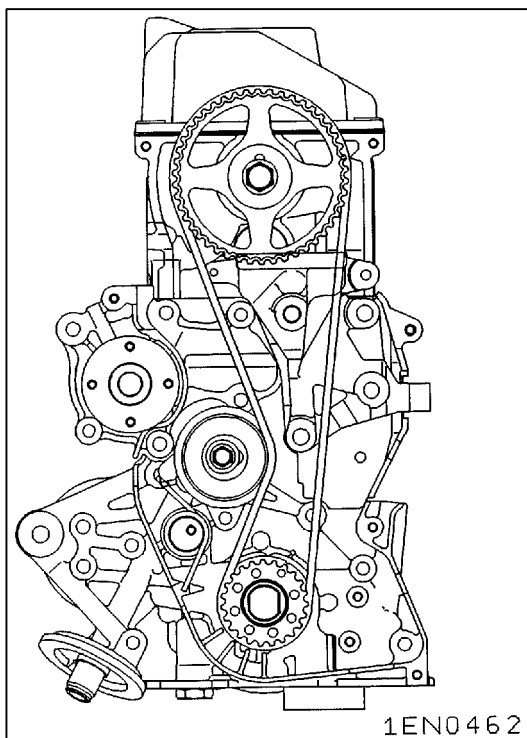


### ▶◀ TIMING BELT INSTALLATION

- (1) Align the camshaft timing mark with the timing mark on the cylinder head.



- (2) Align the crankshaft timing mark with the timing mark on the front case.

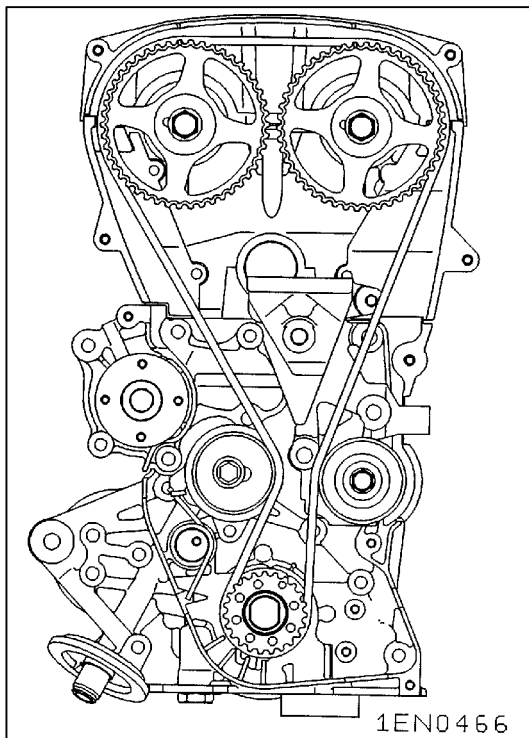
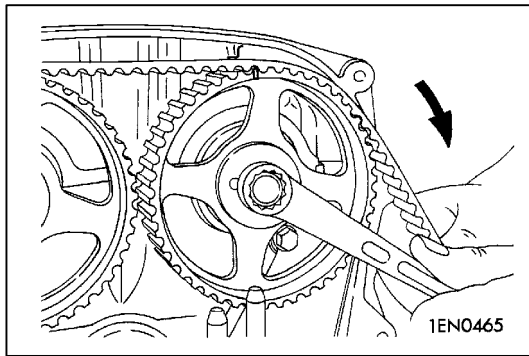
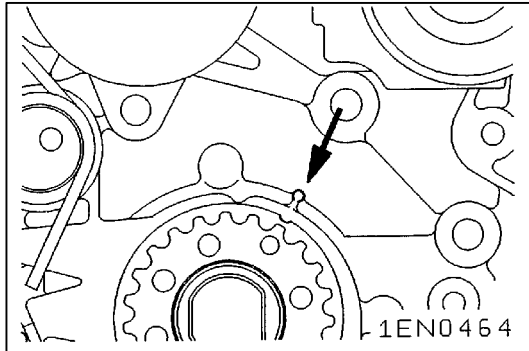
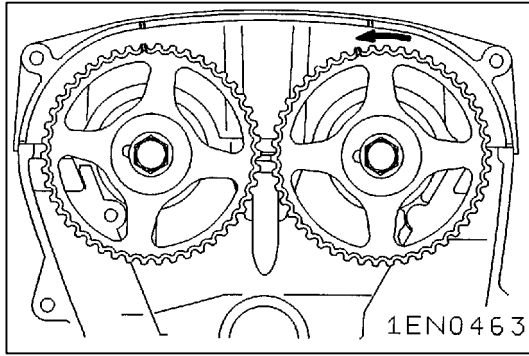


- (3) Keeping the tension side of the timing belt tight, fit the timing belt onto the crankshaft sprocket, camshaft sprocket, and tensioner pulley in that order.
- (4) Loosen the tensioner pulley mounting bolts by 1/4 to 1/2 of a turn and allow the tensioner spring to apply tension to the timing belt.
- (5) Turn the crankshaft twice in the normal rotating direction (clockwise) and check that the timing marks are correctly aligned.

#### Caution

This procedure utilizes the camshaft's driving torque to apply tension evenly to the timing belt. Be sure to turn the crankshaft as described above. Do not turn the crankshaft in reverse.

- (6) Tighten the tensioner pulley mounting bolts.



### ►D◄ TIMING BELT INSTALLATION

- (1) Place the camshaft sprocket timing marks at the positions shown.

#### NOTE

After aligning the sprocket timing marks, let go of the sprockets. The exhaust camshaft sprocket will rotate by one tooth in the direction shown and remain stable in this position.

- (2) Align the crankshaft timing mark with the timing mark on the front case.

- (3) Turn the exhaust camshaft sprocket in the direction shown and fit the timing belt with the timing marks aligned.
- (4) Use a bulldog clip to prevent the timing belt teeth from jumping.

- (5) Fit the timing belt onto the idler pulley, crankshaft sprocket, and tensioner pulley in that order.

#### NOTE

When fitting the belt, keep the camshaft sprocket timing marks correctly aligned and keep the tension side of the belt tight.

- (6) Loosen the tensioner pulley mounting bolts by  $\frac{1}{4}$  to  $\frac{1}{2}$  of a turn and allow the tensioner spring to apply tension to the timing belt.
- (7) Remove the bulldog clip.
- (8) Turn the crankshaft twice in the normal rotating direction (clockwise) and check that the timing marks are correctly aligned.

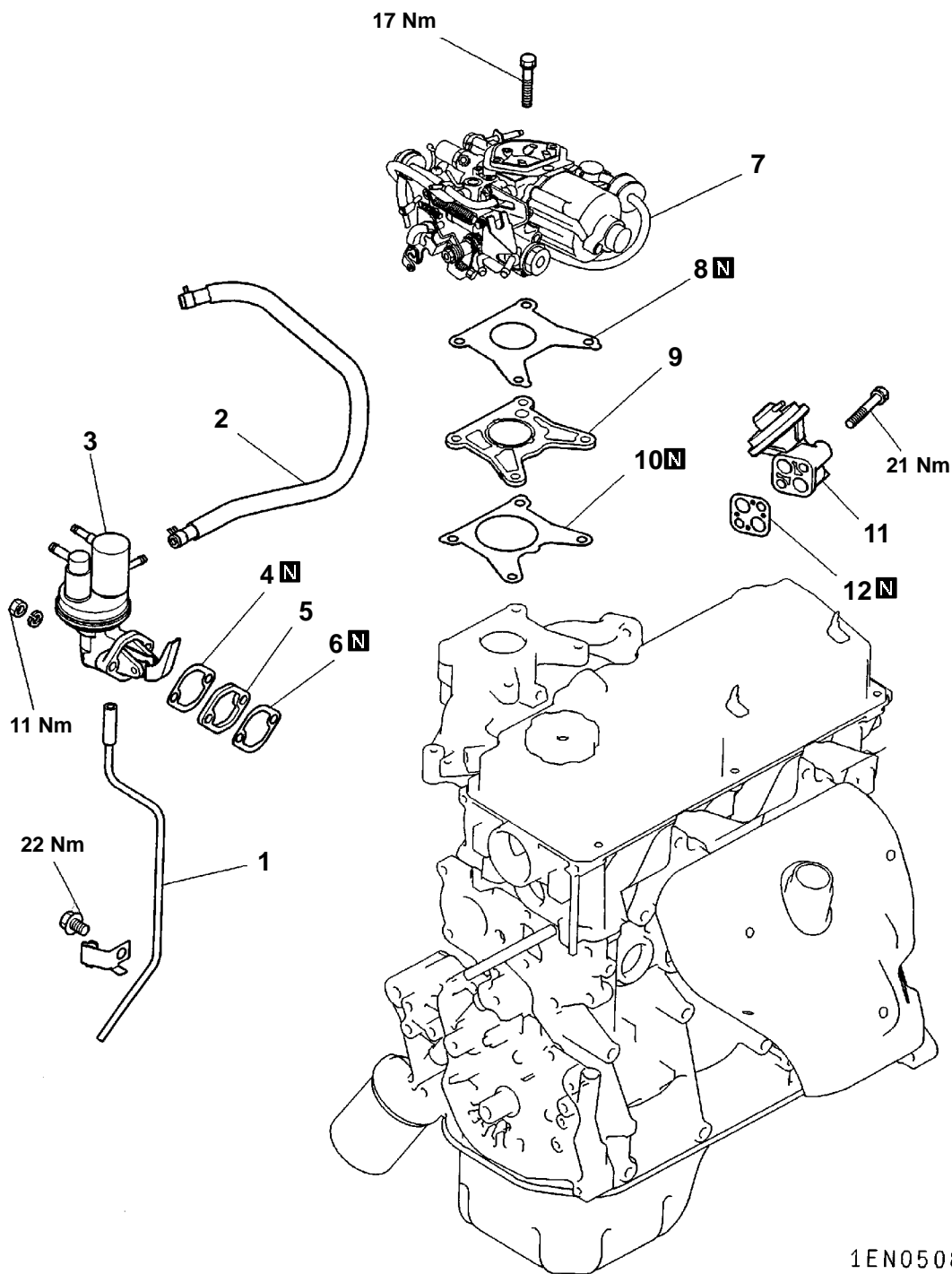
#### Caution

**This procedure utilizes the camshaft's driving torque to apply tension evenly to the timing belt. Be sure to turn the crankshaft as described above. Do not turn the crankshaft in reverse.**

- (9) Tighten the tensioner pulley mounting bolts.

## 5. FUEL AND EMISSION CONTROL SYSTEMS

### REMOVAL AND INSTALLATION <SOHC-CARBURETOR>



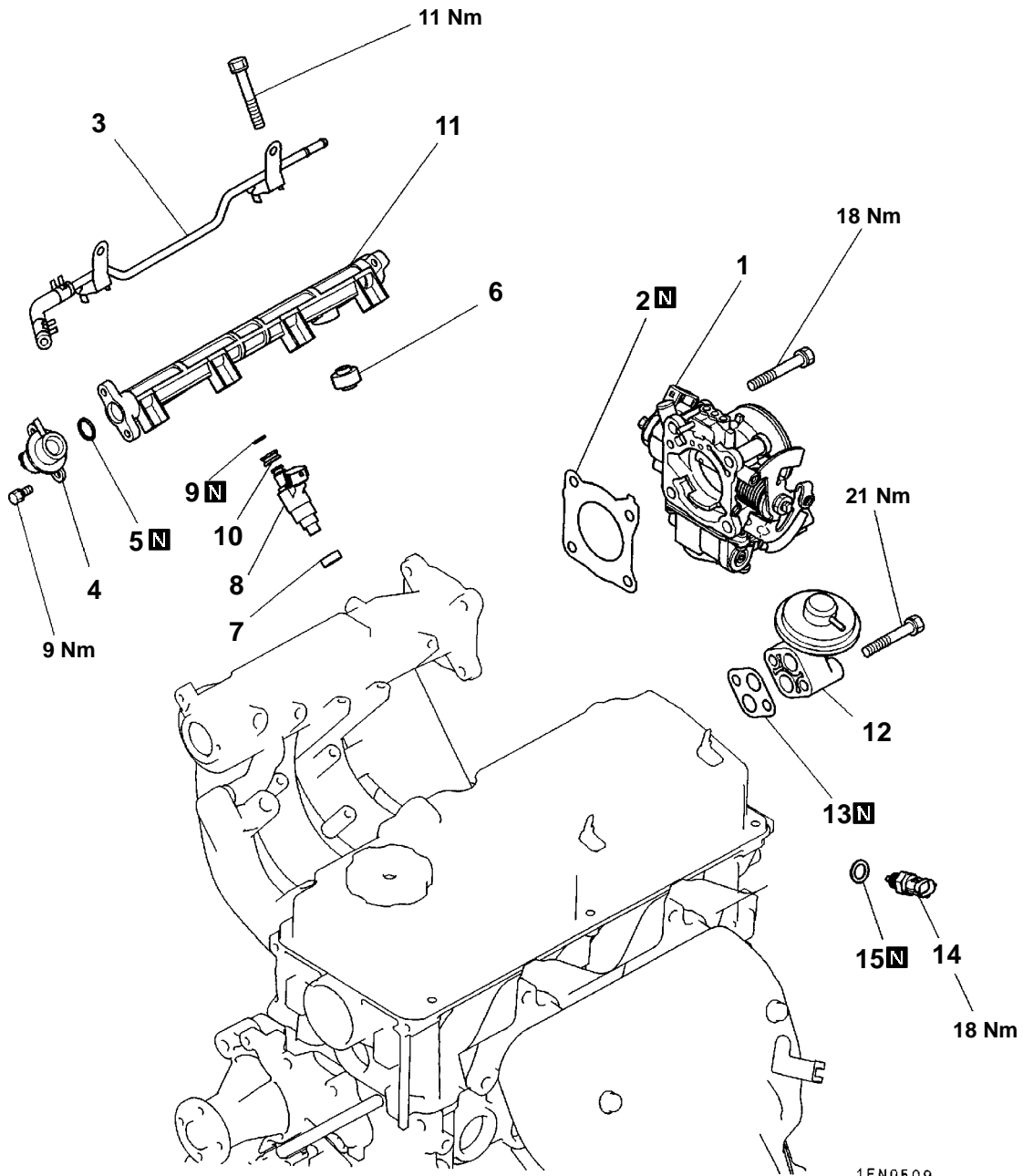
1EN0508

#### Removal steps

1. Breather tube
2. Fuel hose
3. Fuel pump
4. Gasket
5. Insulator
6. Gasket

7. Carburetor
8. Upper gasket
9. Spacer
10. Lower gasket
11. EGR valve (vehicles with automatic transmission for GCC only)
12. Gasket

REMOVAL AND INSTALLATION <SOHC-MPI>

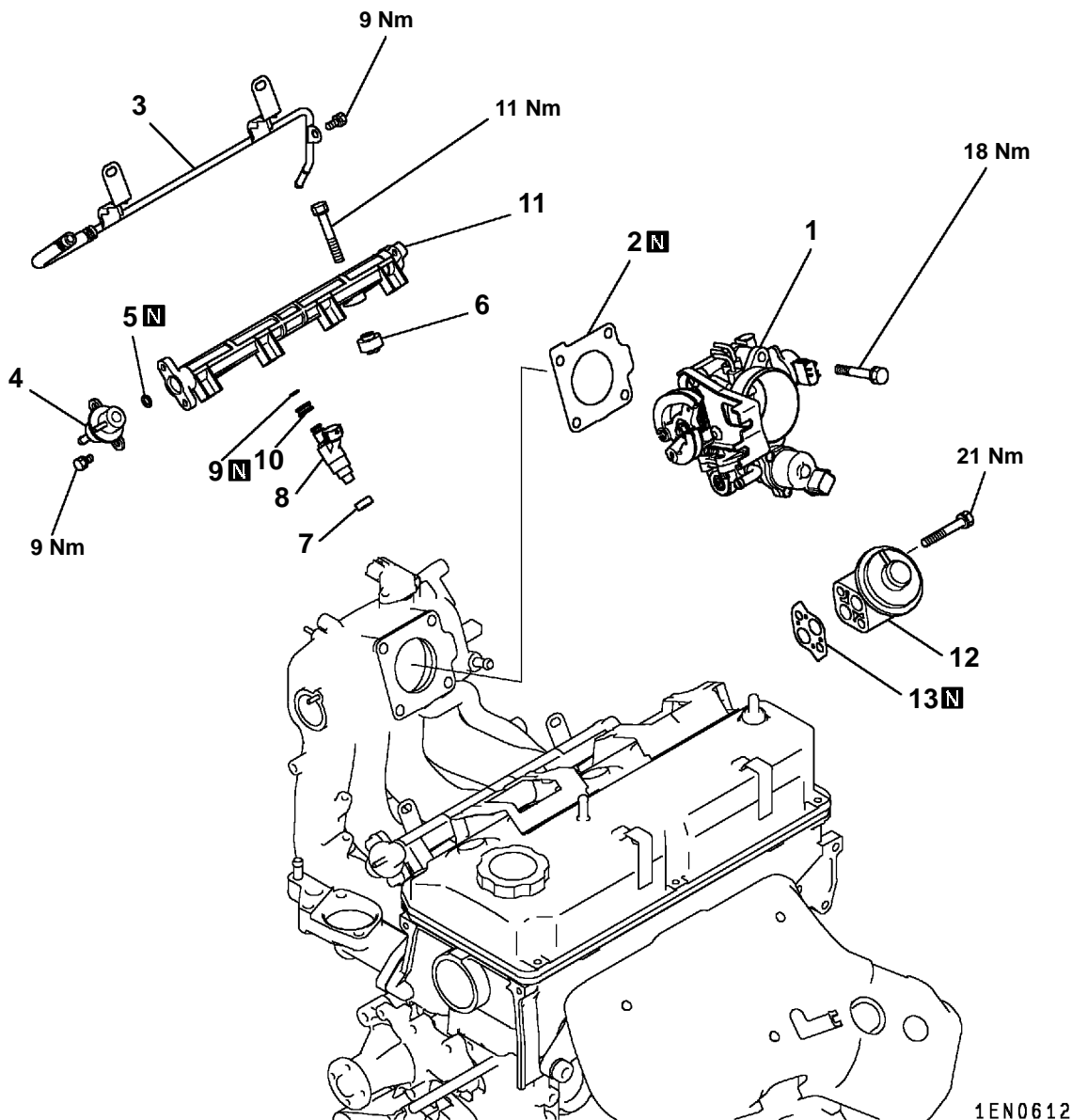


1EN0509

**Removal steps**

- |   |  |
|---|--|
| <p>►B◄</p> <ol style="list-style-type: none"> <li>1. Throttle body assembly</li> <li>2. Gasket</li> <li>3. Fuel return pipe</li> <li>4. Fuel pressure regulator</li> <li>5. O-ring</li> <li>6. Insulator</li> <li>7. Insulator</li> </ol> | <p>►A◄</p> <ol style="list-style-type: none"> <li>8. Injector</li> <li>9. O-ring</li> <li>10. Grommet</li> <li>11. Delivery pipe</li> <li>12. EGR valve</li> <li>13. Gasket</li> <li>14. Air temperature sensor</li> <li>15. Gasket</li> </ol> |
|---|--|

REMOVAL AND INSTALLATION <SOHC-REAR WHEEL DRIVE>



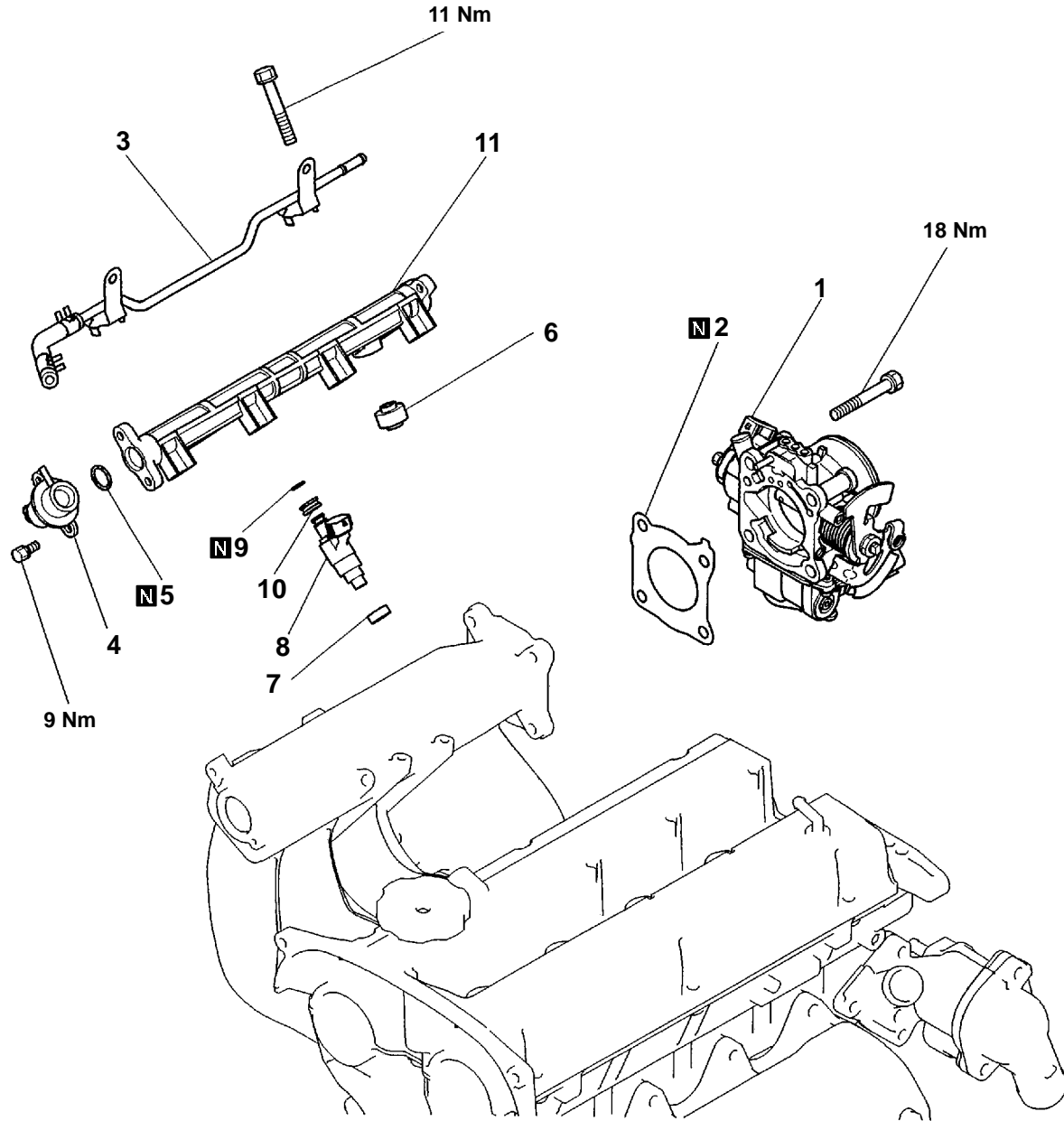
1EN0612

Removal steps

- |   |  |
|---|--|
| <p>►B◄</p> <ol style="list-style-type: none"> <li>1. Throttle body assembly</li> <li>2. Gasket</li> <li>3. Fuel return pipe</li> <li>4. Fuel pressure regulator</li> <li>5. O-ring</li> <li>6. Insulator</li> <li>7. Insulator</li> </ol> | <p>►A◄</p> <ol style="list-style-type: none"> <li>8. Injector</li> <li>9. O-ring</li> <li>10. Grommet</li> <li>11. Delivery pipe</li> <li>12. EGR valve</li> <li>13. Gasket</li> </ol> |
|---|--|

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REMOVAL AND INSTALLATION <DOHC>



1EN0468

Removal steps

- |   |   |
|---|---|
| <p>►B◄</p> <ol style="list-style-type: none"> <li>1. Throttle body assembly</li> <li>2. Gasket</li> <li>3. Fuel return pipe</li> <li>4. Fuel pressure regulator</li> <li>5. O-ring</li> <li>6. Insulator</li> </ol> | <p>►A◄</p> <ol style="list-style-type: none"> <li>7. Insulator</li> <li>8. Injector</li> <li>9. O-ring</li> <li>10. Grommet</li> <li>11. Delivery pipe</li> </ol> |
|---|---|

**INSTALLATION SERVICE POINTS****▶A◀ INJECTOR INSTALLATION**

- (1) Fit a new O-ring and grommet onto the injector.
- (2) Apply spindle oil or gasoline to the injector O-ring.

- (3) Fit the injector onto the delivery pipe, turning it to the left and right as it goes in.
- (4) Check that the injector rotates smoothly.

**Caution**

**If the injector does not rotate smoothly, its O-ring may be binding. If this occurs, remove the injector from the delivery pipe, check the O-ring, and re-insert the injector.**

**▶B◀ FUEL PRESSURE REGULATOR INSTALLATION**

- (1) Apply a little new engine oil to the O-ring, then insert the fuel pressure regulator into the delivery pipe, taking care not to damage the O-ring.

**Caution**

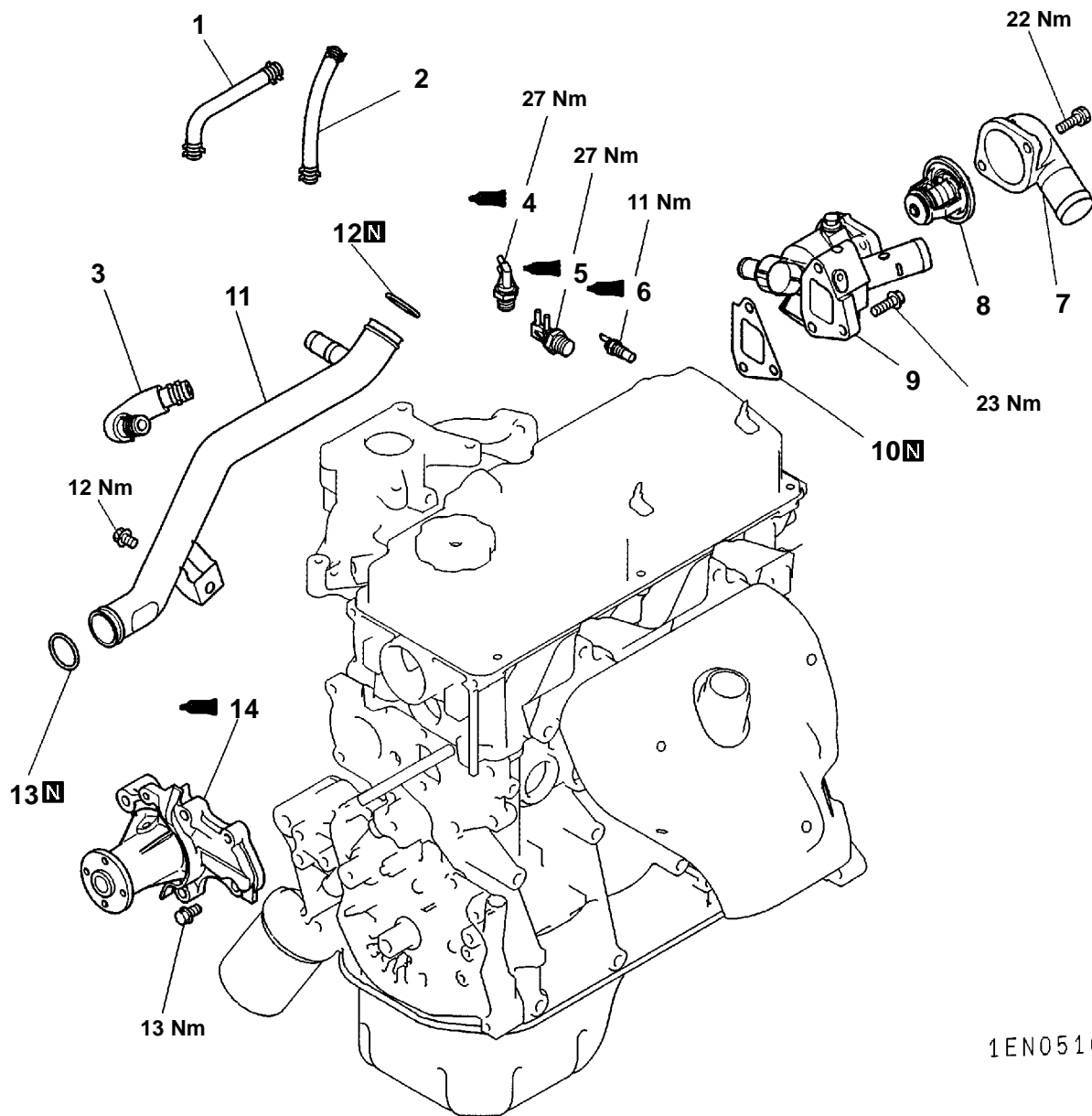
**Ensure that no engine oil enters the delivery pipe.**

- (2) Check that the fuel pressure regulator rotates smoothly. If it does not rotate smoothly, the O-ring may be binding. If this occurs, remove the fuel pressure regulator, check the O-ring for damage, then re-insert the regulator into the delivery pipe.



## 6. WATER PUMP AND WATER HOSE

### REMOVAL AND INSTALLATION <SOHC-CARBURETOR>



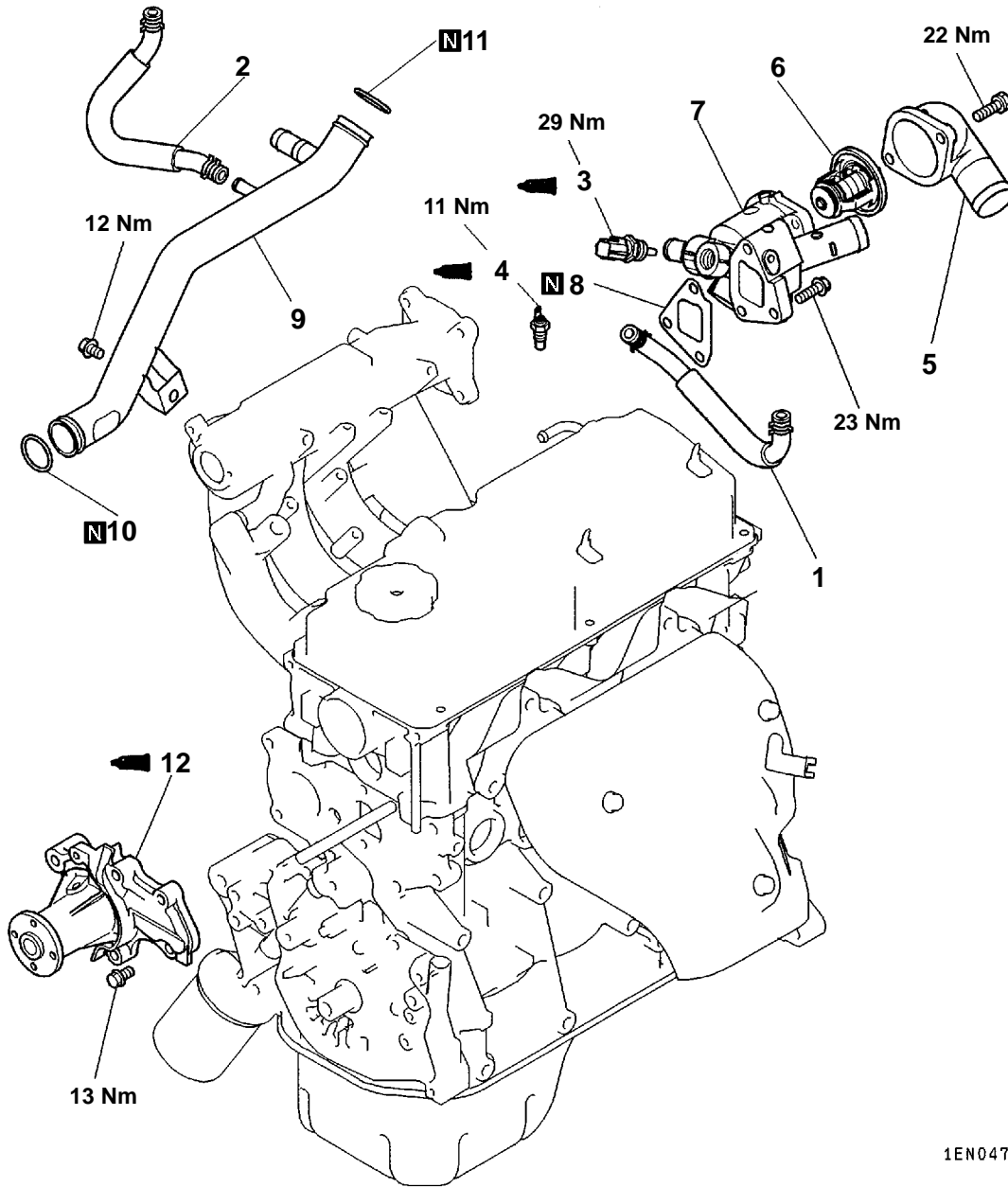
1EN0510

#### Removal steps

1. Water hose
2. Water hose
3. Water hose
- ▶F▶ 4. Thermo valve (engines with EGR)
- ▶F▶ 5. Thermo valve
- ▶D▶ 6. Water temperature gauge unit
7. Water inlet fitting

- ▶C▶ 8. Thermostat
9. Thermostat case
10. Gasket
- ▶B▶ 11. Water inlet pipe
- ▶B▶ 12. O-ring
- ▶B▶ 13. O-ring
- ▶A▶ 14. Water pump

REMOVAL AND INSTALLATION <SOHC-MPI>



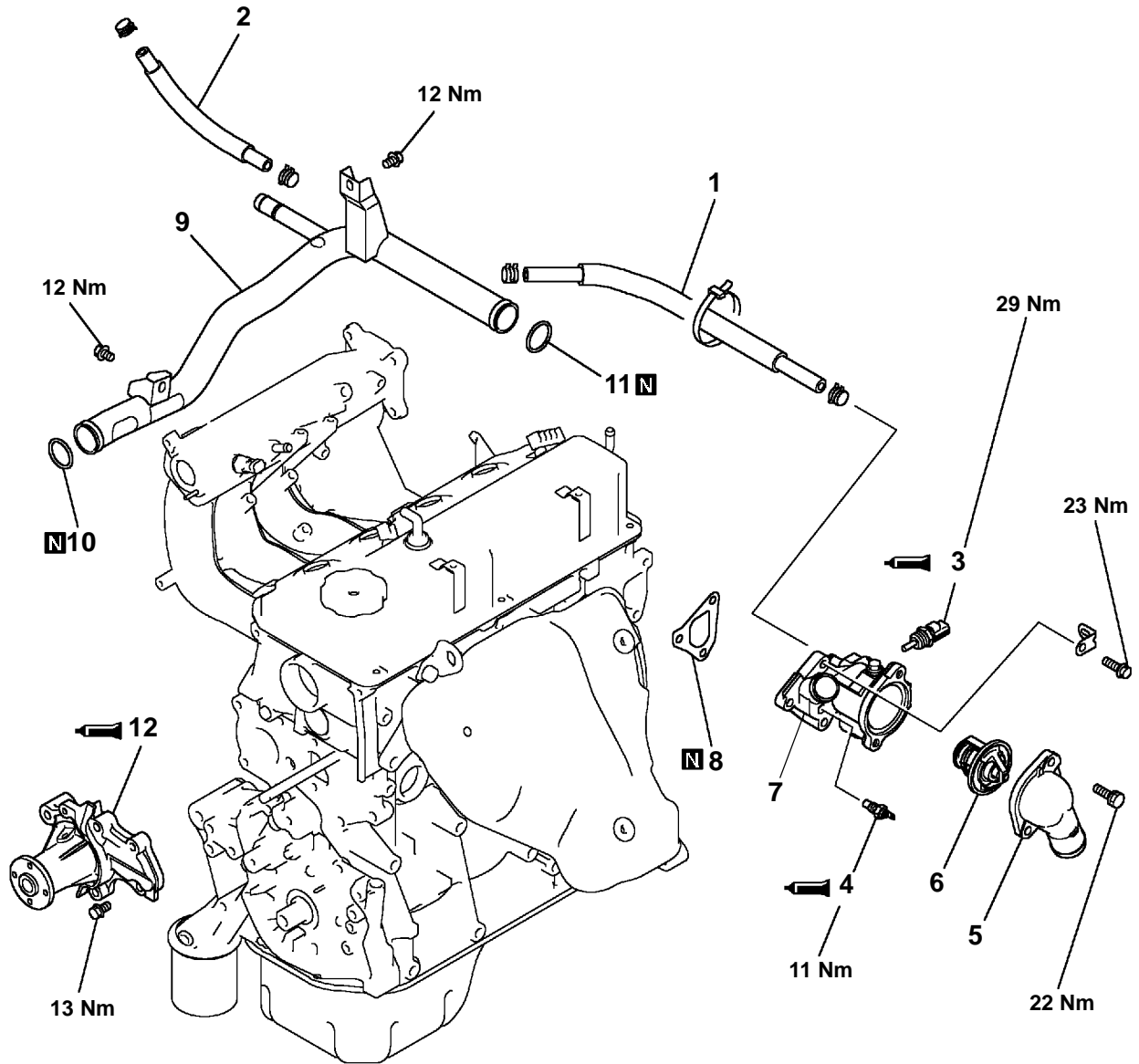
1EN0471

Removal steps

- 1. Water hose
- 2. Water hose
- ▶E▶ 3. Water temperature sensor
- ▶D▶ 4. Water temperature gauge unit
- ▶C▶ 5. Water inlet fitting
- 6. Thermostat
- 7. Thermostat case

- 8. Gasket
- ▶B▶ 9. Water inlet pipe
- ▶B▶ 10. O-ring
- ▶B▶ 11. O-ring
- ▶A▶ 12. Water pump

REMOVAL AND INSTALLATION <SOHC 16-VALVE-MPI-FRONT WHEEL DRIVE>



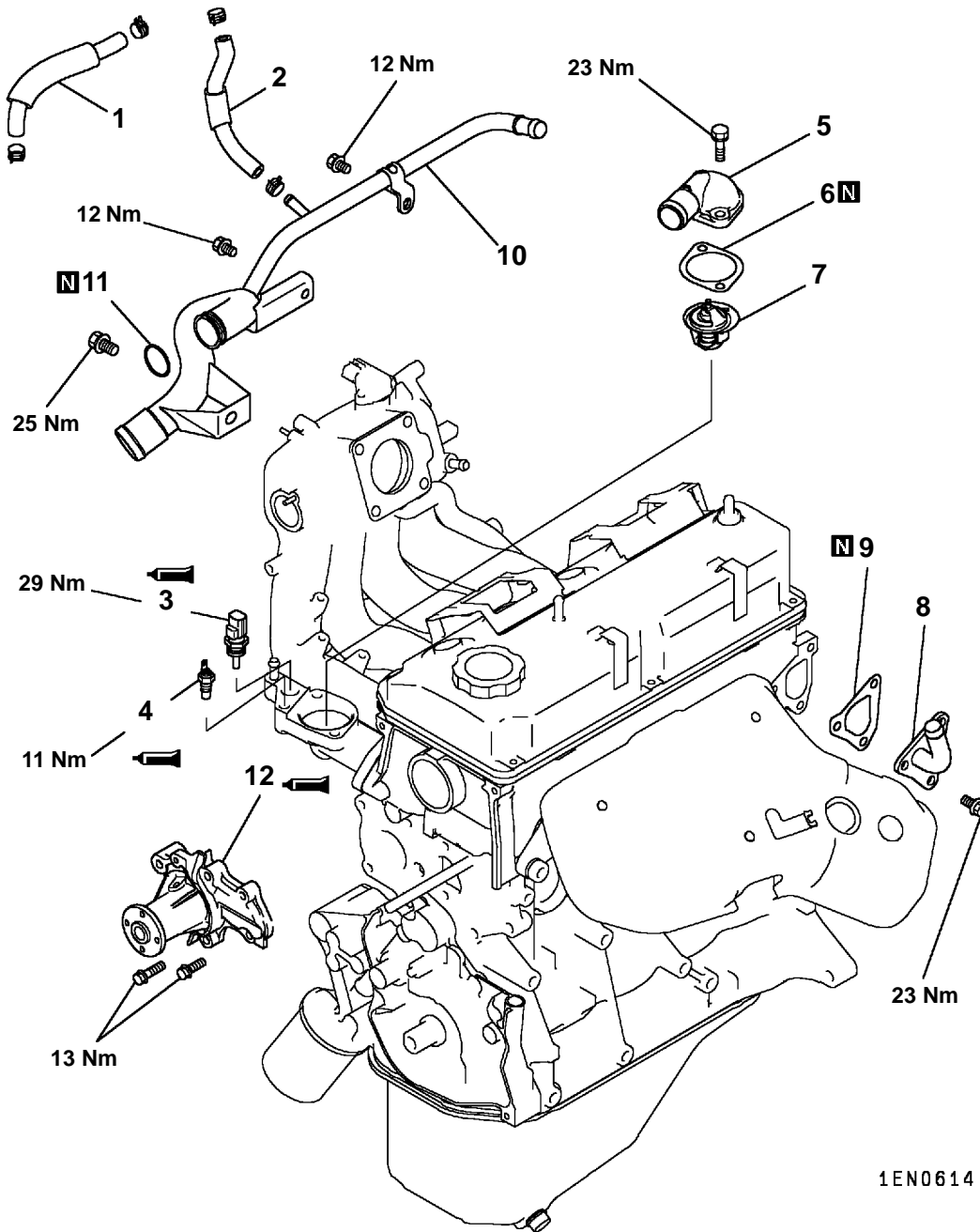
6EN0613

Removal steps

- 1. Water hose
- 2. Water hose
- ▶E▶▶D▶▶C▶ 3. Water temperature sensor
- 4. Water temperature gauge unit
- 5. Water inlet fitting
- 6. Thermostat
- 7. Thermostat case

- 8. Gasket
- ▶B▶▶B▶▶B▶▶A▶ 9. Water inlet pipe
- 10. O-ring
- 11. O-ring
- 12. Water pump

REMOVAL AND INSTALLATION <SOHC 16-VALVE-MPI-REAR WHEEL DRIVE>



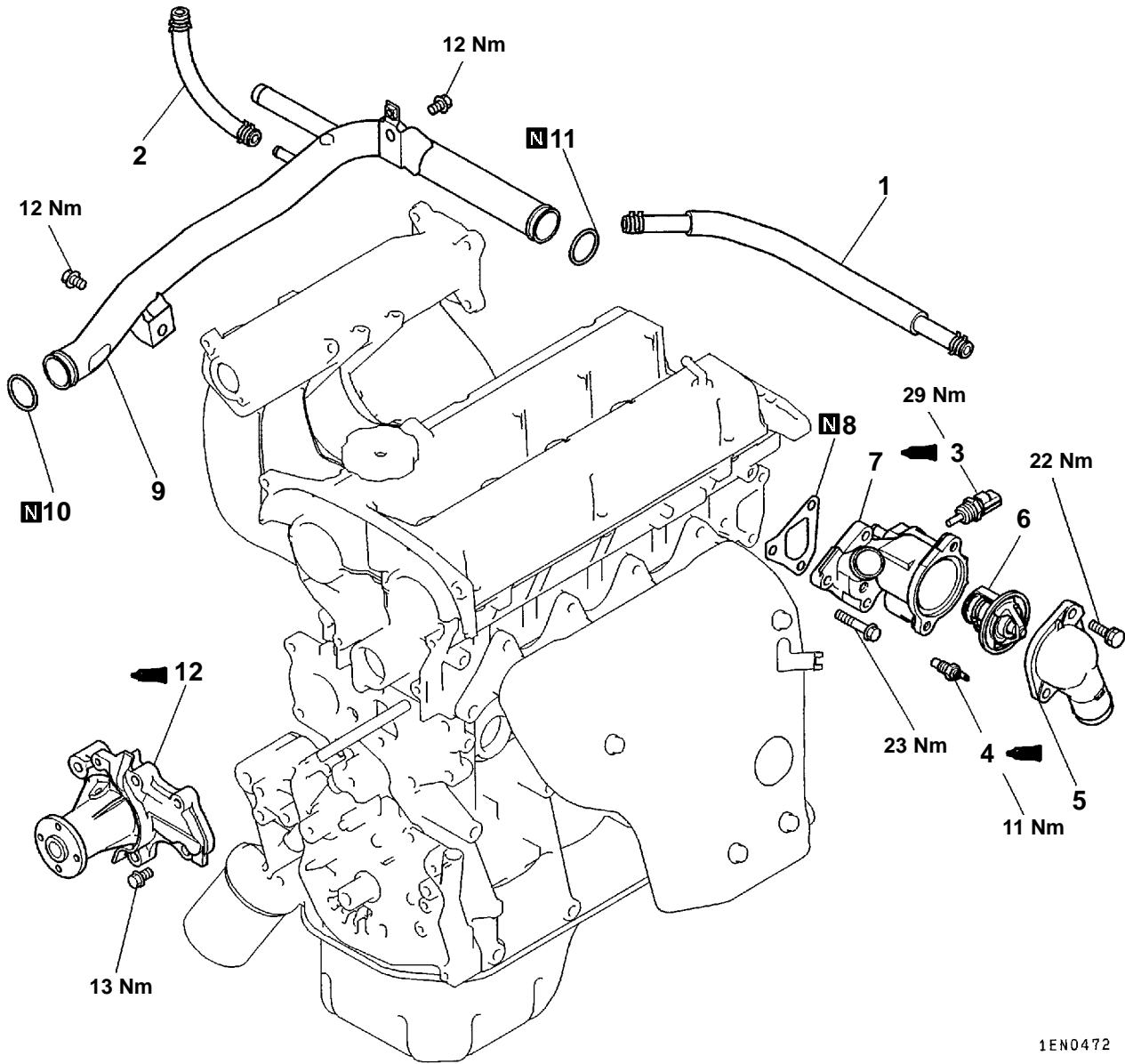
1EN0614

Removal steps

- 1. Water hose
- 2. Water hose
- ▶E▶▶D▶ 3. Water temperature sensor
- ▶D▶▶ 4. Water temperature gauge unit
- 5. Water outlet fitting
- 6. Gasket

- ▶C▶▶ 7. Thermostat
- 8. Fitting
- 9. Gasket
- ▶B▶▶▶B▶▶▶A▶▶ 10. Water inlet pipe
- ▶B▶▶▶B▶▶▶A▶▶▶ 11. O-ring
- ▶A▶▶▶ 12. Water pump

REMOVAL AND INSTALLATION <DOHC>

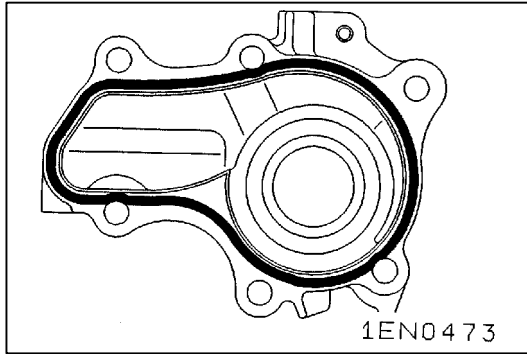


1EN0472

Removal steps

- 1. Water hose
- 2. Water hose
- ▶E▶ 3. Water temperature sensor
- ▶D▶ 4. Water temperature gauge unit
- ▶C▶ 5. Water inlet fitting
- ▶C▶ 6. Thermostat
- 7. Thermostat case

- 8. Gasket
- ▶B▶ 9. Water inlet pipe
- ▶B▶ 10. O-ring
- ▶B▶ 11. O-ring
- ▶A▶ 12. Water pump



## INSTALLATION SERVICE POINTS

### ▶A◀ WATER PUMP INSTALLATION

- (1) Apply a 3 mm bead of form-in-place gasket (FIPG) to the mounting surface.

#### Specified sealant:

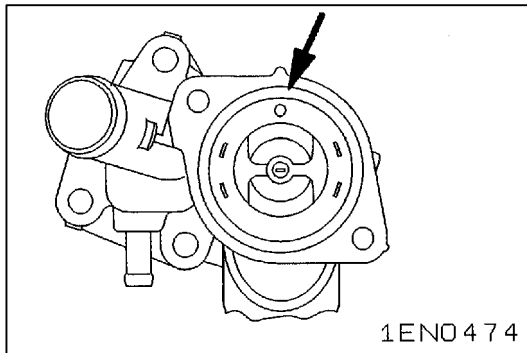
**Mitsubishi Genuine Part No. MD970389 or equivalent.**

### ▶B◀ O-RING / WATER PIPE INSTALLATION

- (1) Replace the water inlet pipe O-rings with new ones, then apply water to the O-rings so that they can be inserted easily into the water pump and thermostat case.

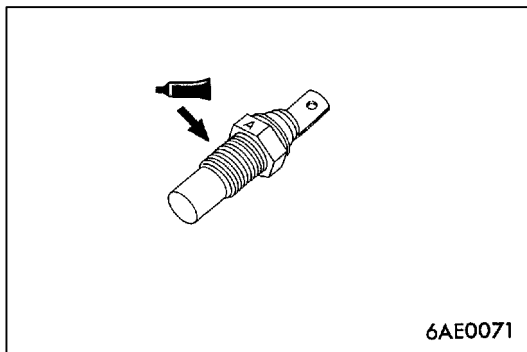
#### Caution

1. Do not apply engine oil or any other oily substance to the O-rings.
2. Secure the water pipe after the thermostat case has been installed.



### ▶C◀ THERMOSTAT INSTALLATION

- (1) Fit the thermostat such that its jiggle valve is at the top.

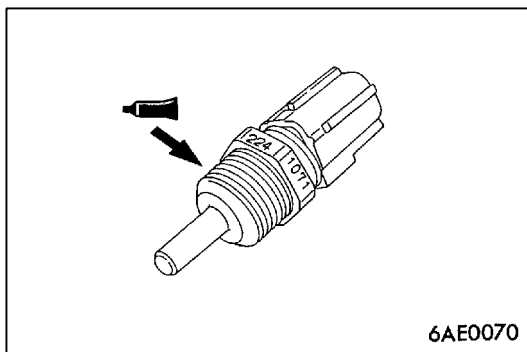


### ▶D◀ WATER TEMPERATURE GAUGE UNIT INSTALLATION

- (1) If the water temperature gauge unit is to be reused, apply the specified sealant to its thread.

#### Specified sealant:

**3M ATD Part No. 8660 or equivalent.**

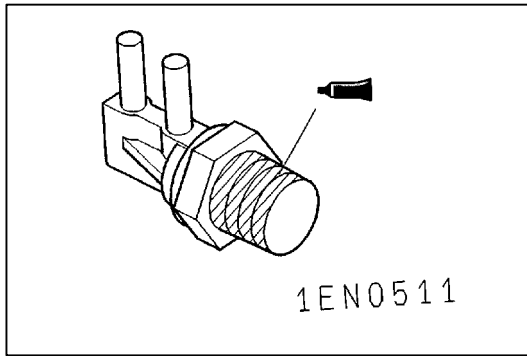


### ▶E◀ WATER TEMPERATURE SENSOR INSTALLATION

- (1) If the water temperature sensor is to be reused, apply the specified sealant to its thread.

#### Specified sealant:

**3M Nut Locking Part No. 4171 or equivalent.**

**►F◄ THERMO VALVE INSTALLATION**

- (1) If the thermo valve is to be reused, apply the specified sealant to its thread.

**Specified sealant:**

**Mitsubishi Genuine Part No. MD970389 or equivalent.**

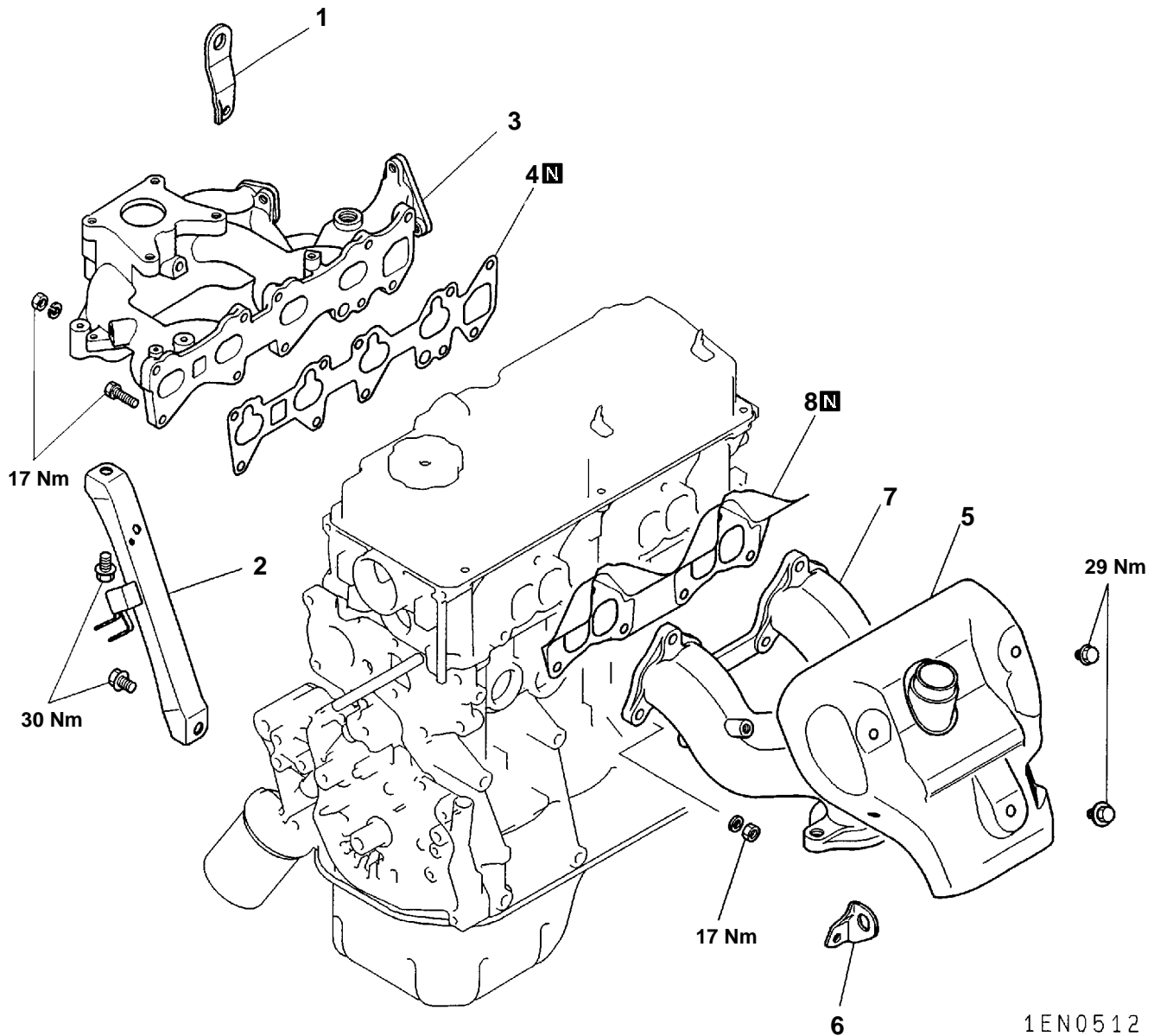
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## NOTES



## 7. INTAKE AND EXHAUST MANIFOLDS

### REMOVAL AND INSTALLATION <SOHC-CARBURETOR>

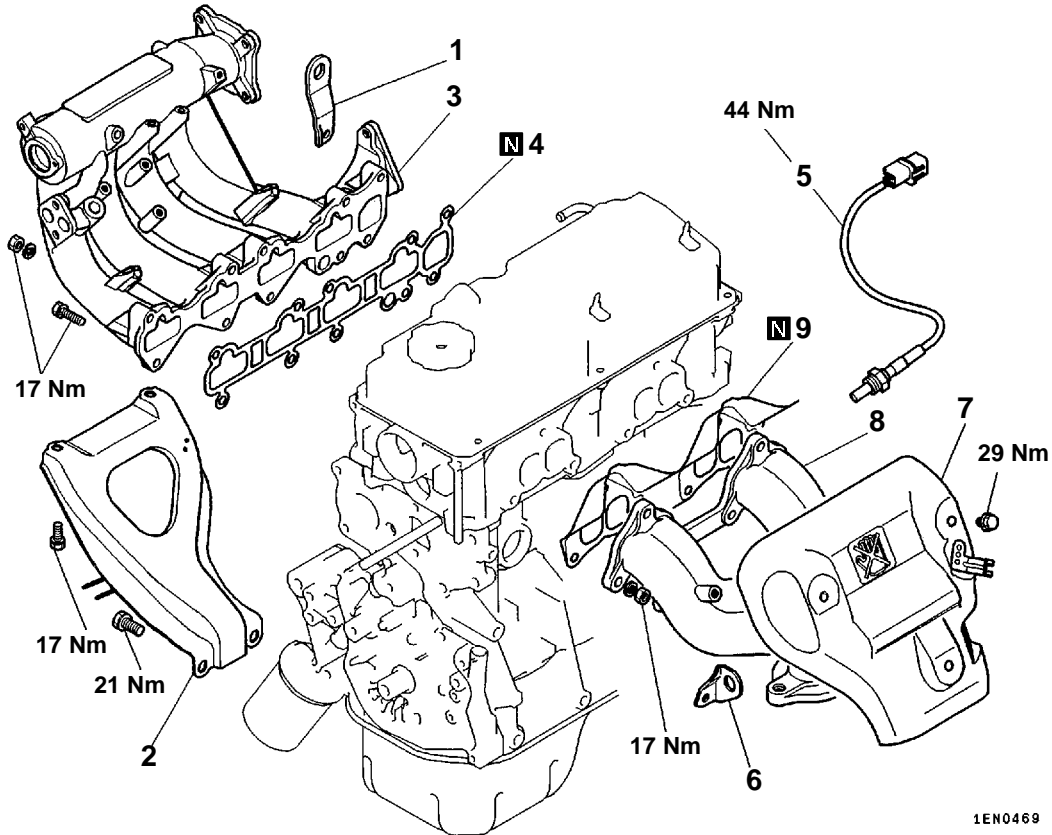


#### Removal steps

1. Engine hanger
2. Intake manifold stay
3. Intake manifold
4. Intake manifold gasket

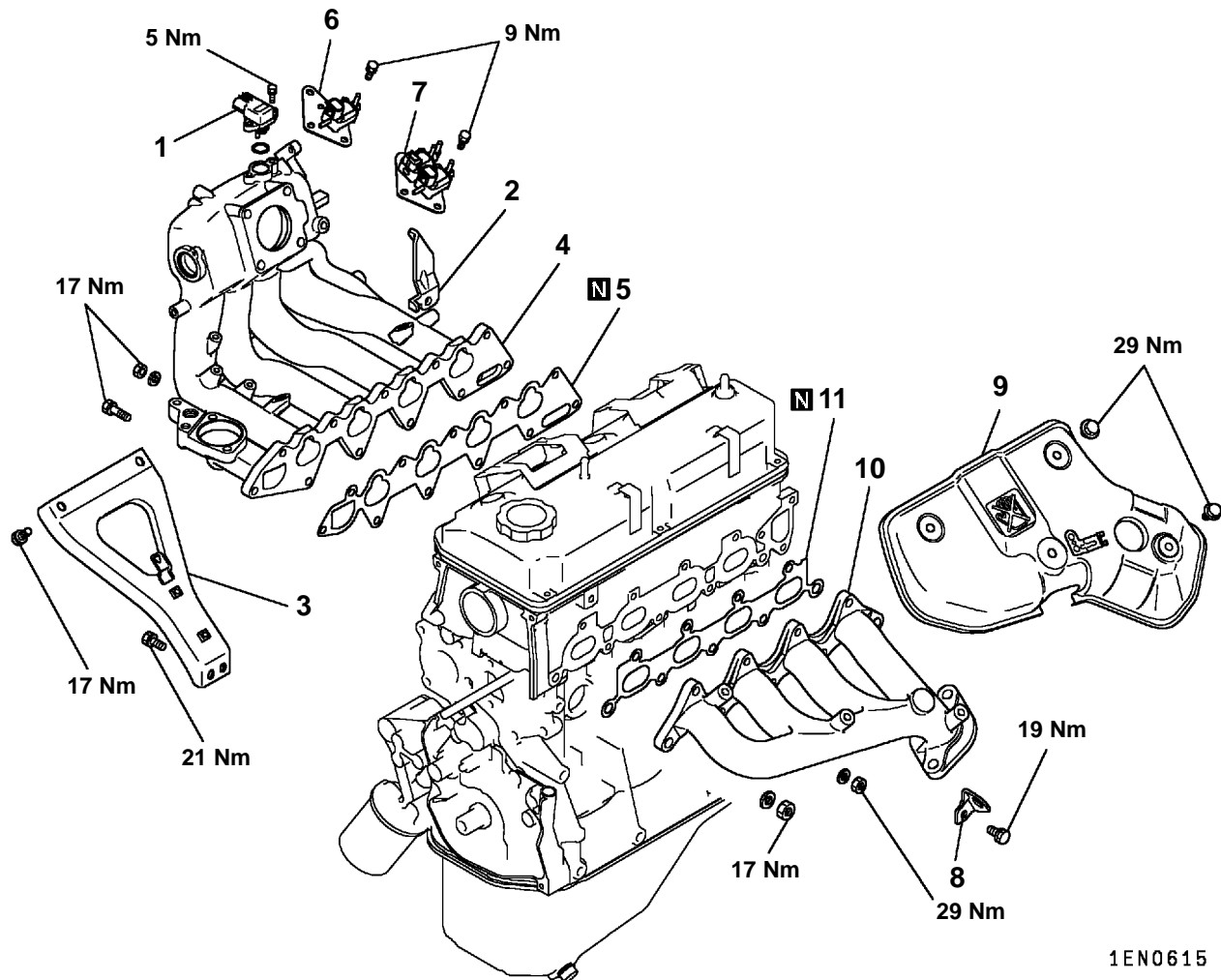
5. Exhaust manifold cover
6. Engine hanger
7. Exhaust manifold
8. Exhaust manifold gasket

## REMOVAL AND INSTALLATION &lt;SOHC-MPI&gt;

**Removal steps**

- |  |                            |
|--|----------------------------|
| 1. Engine hanger                               | 6. Exhaust manifold cover  |
| 2. Intake manifold stay                        | 7. Engine hanger           |
| 3. Intake manifold                             | 8. Exhaust manifold        |
| 4. Intake manifold gasket                      | 9. Exhaust manifold gasket |
| 5. Oxygen sensor (vehicles for Hong Kong only) |                            |

## REMOVAL AND INSTALLATION &lt;SOHC 16-VALVE-MPI-REAR WHEEL DRIVE&gt;

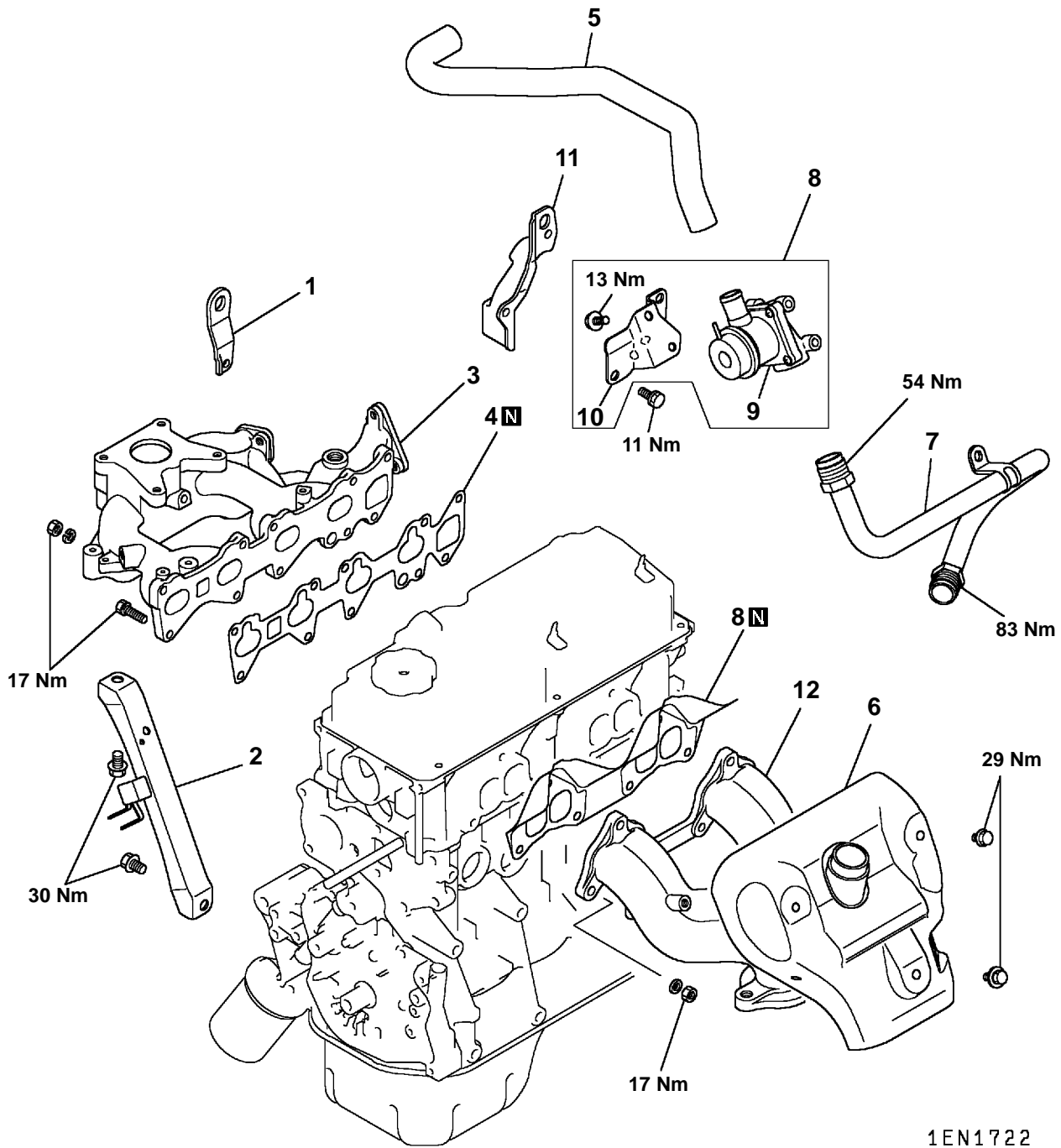


1EN0615

**Removal steps**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Boost sensor</li> <li>2. Engine hanger</li> <li>3. Intake manifold stay</li> <li>4. Intake manifold</li> <li>5. Intake manifold gasket</li> <li>6. Solenoid valve assembly &lt;Without catalytic converter&gt;</li> </ol> | <ol style="list-style-type: none"> <li>7. Solenoid valve assembly &lt;With catalytic converter&gt;</li> <li>8. Engine hanger</li> <li>9. Exhaust manifold cover</li> <li>10. Exhaust manifold</li> <li>11. Exhaust manifold gasket</li> </ol> |
|---|---|

REMOVAL AND INSTALLATION <SOHC-CARBURETOR FOR CENTRAL AMERICA>



1EN1722

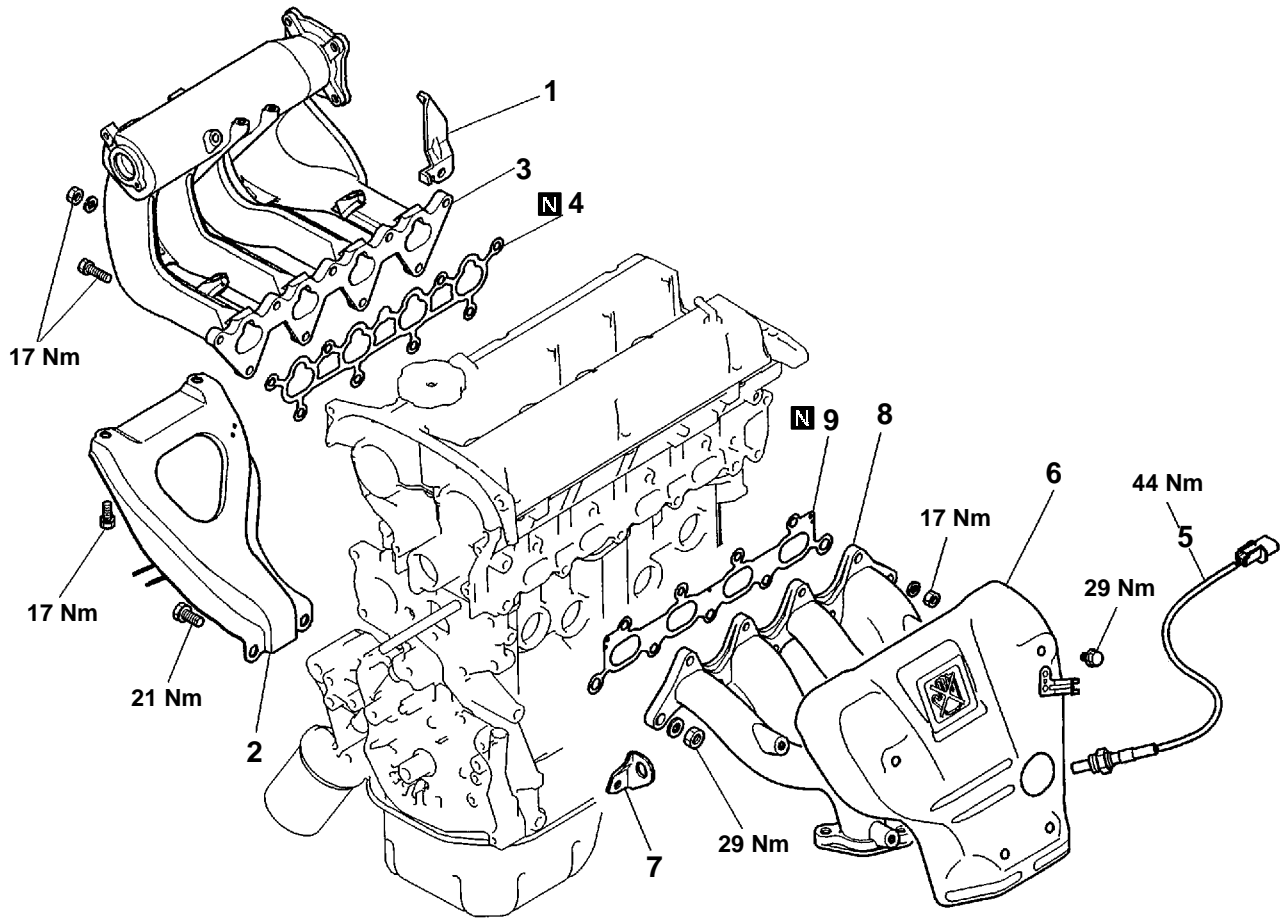
**Removal steps**

1. Engine hanger
2. Intake manifold stay
3. Intake manifold
4. Intake manifold gasket
5. Air hose
6. Exhaust manifold cover



7. Air pipe
8. Reed valve and bracket
9. Reed valve
10. Reed valve bracket "A"
11. Reed valve bracket "B"
12. Exhaust manifold

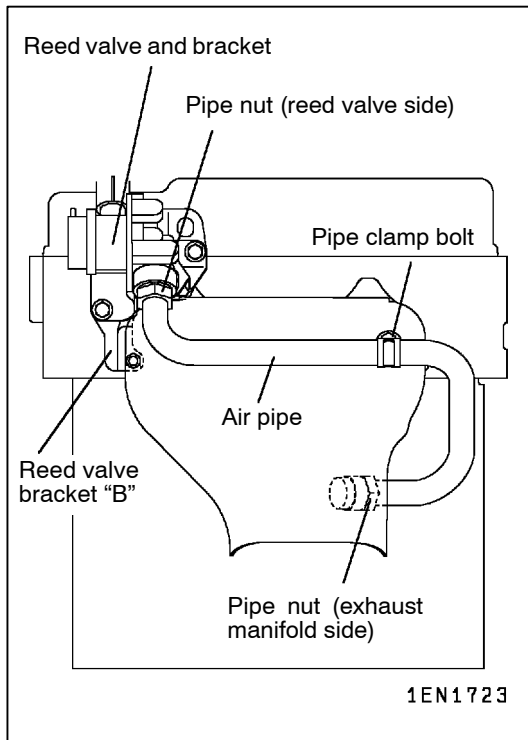
## REMOVAL AND INSTALLATION &lt;DOHC&gt;



1EN0470

**Removal steps**

- |                           |                            |
|---------------------------|----------------------------|
| 1. Engine hanger          | 6. Exhaust manifold cover  |
| 2. Intake manifold stay   | 7. Engine hanger           |
| 3. Intake manifold        | 8. Exhaust manifold        |
| 4. Intake manifold gasket | 9. Exhaust manifold gasket |
| 5. Oxygen sensor          |                            |



## INSTALLATION SERVICE POINTS

### ▶◀ REED VALVE, BRACKET AND AIR PIPE INSTALLATION

- (1) Insert the lower end of the air pipe into the exhaust manifold, then tighten the pipe nut temporarily.
- (2) Fit the upper end of the air pipe to the reed valve and bracket assembly, then tighten the pipe nut temporarily.
- (3) Attach the reed valve and bracket assembly to the reed valve bracket "B" and tighten the mounting bolts temporarily.
- (4) Tighten the nuts on both ends of the air pipe to the specified torque.

#### Caution

**The tightening torque of the reed valve side nut and that of the exhaust manifold side nut are different from each other.**

**Be sure to tighten each nut correctly to the specified torque.**

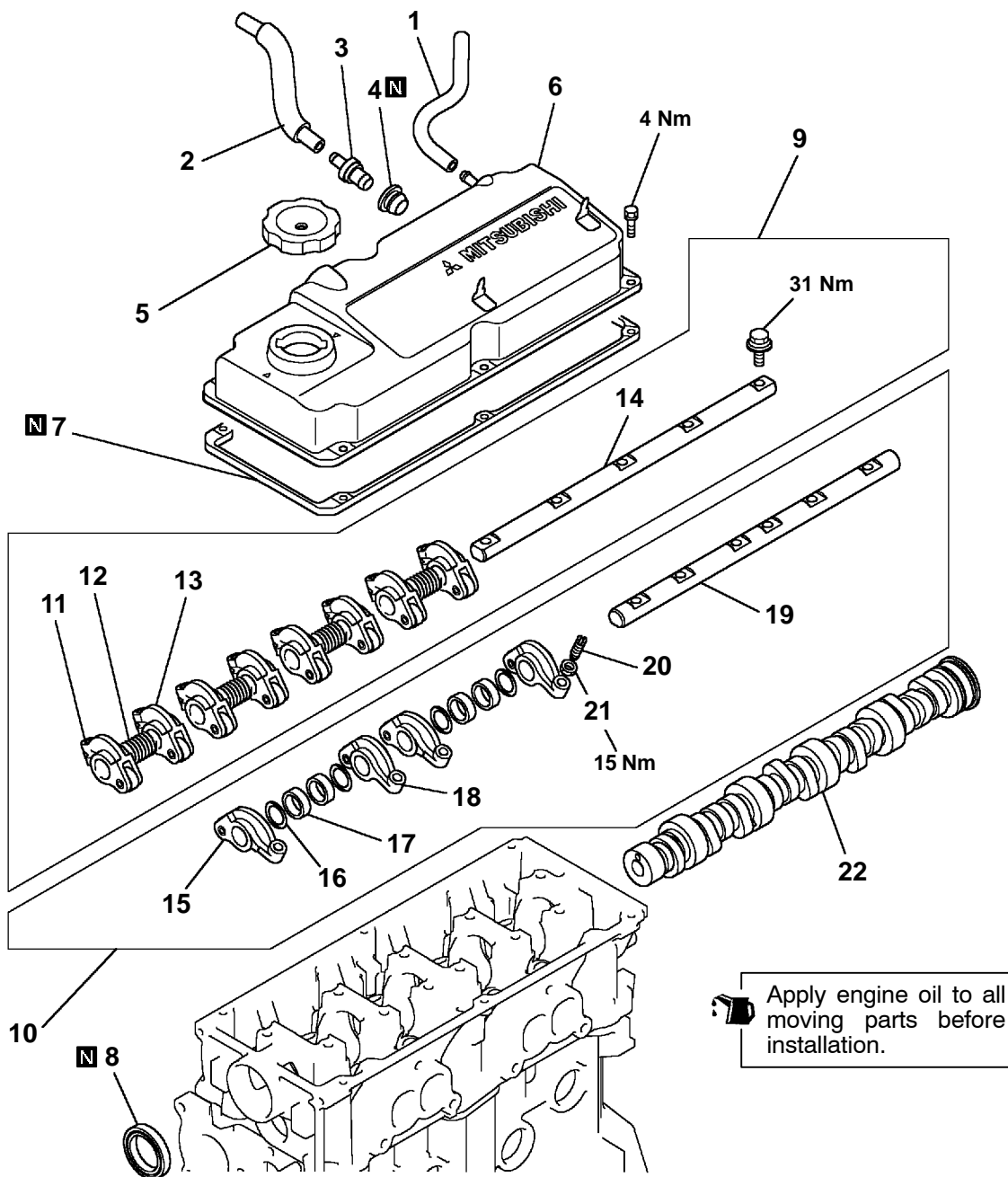
- (5) Tighten the reed valve and bracket mounting bolts to the specified torque.
- (6) Tighten the pipe clamp bolt.

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## NOTES

## 8. ROCKER ARMS AND CAMSHAFTS

## REMOVAL AND INSTALLATION &lt;SOHC 12-VALVE&gt;



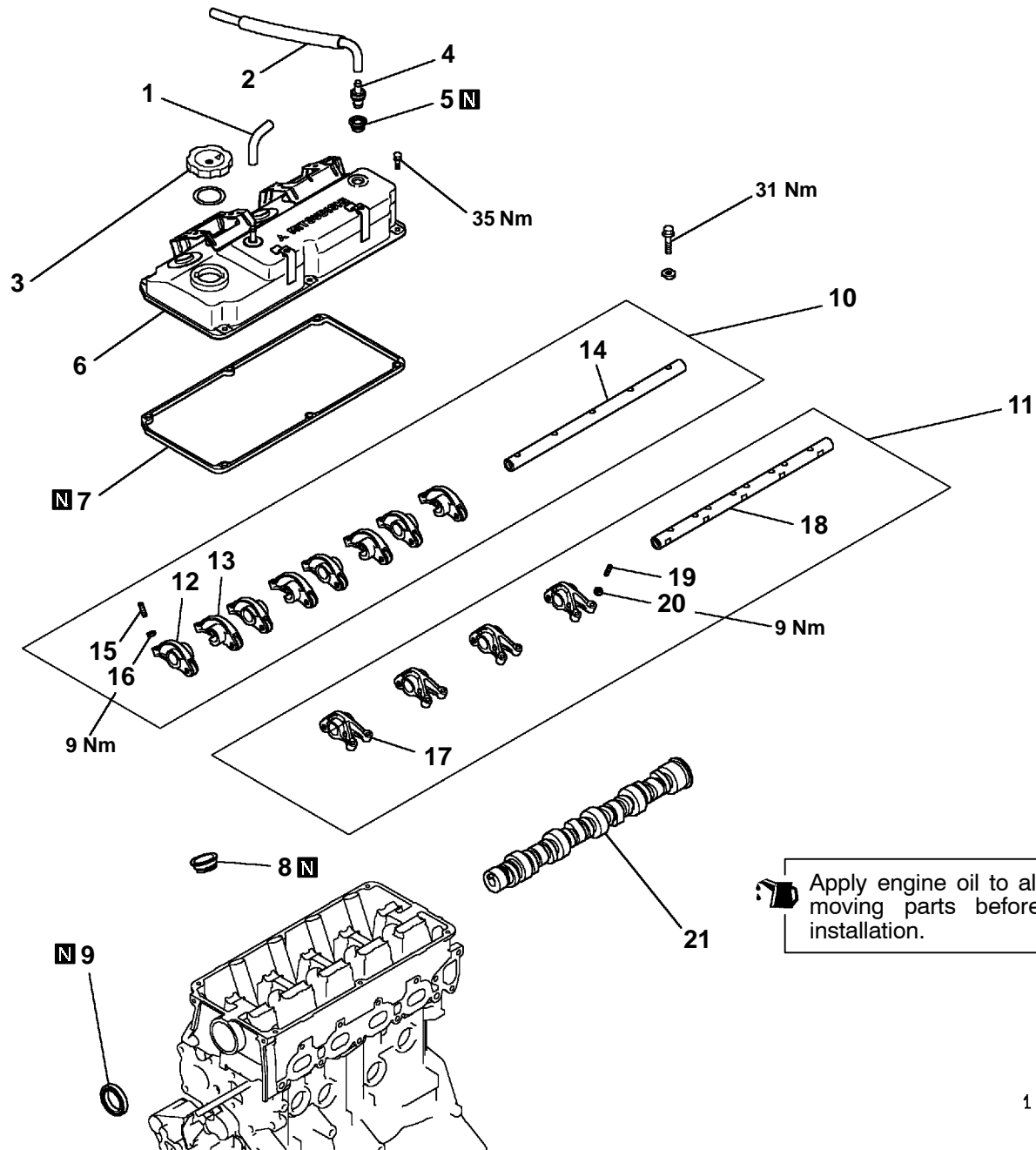
1EN0624

## Removal steps

- |    |                                   |                       |
|----|-----------------------------------|-----------------------|
| ▶F | 1. Breather hose                  | 12. Rocker arm spring |
| ▶E | 2. P.C.V. hose                    | 13. Rocker arm B      |
| ▶E | 3. P.C.V. valve                   | 14. Rocker arm shaft  |
|    | 4. P.C.V. valve gasket            | 15. Rocker arm C      |
|    | 5. Oil filler cap                 | 16. Wave washer       |
|    | 6. Rocker cover                   | 17. Spacer            |
|    | 7. Rocker cover gasket            | 18. Rocker arm D      |
|    | 8. Camshaft oil seal              | 19. Rocker arm shaft  |
|    | 9. Rocker arm and shaft assembly  | ▶C                    |
|    | 10. Rocker arm and shaft assembly | 20. Adjusting screw   |
|    | 11. Rocker arm A                  | 21. Nut               |
|    |                                   | 22. Camshaft          |



## REMOVAL AND INSTALLATION &lt;SOHC 16-VALVE&gt;



1EN0616

**Removal steps**

1. Breather hose
2. P.C.V. hose
3. Oil filler cap
4. P.C.V. valve
5. P.C.V. valve gasket
6. Rocker cover
7. Rocker cover gasket
8. Oil seal
9. Oil seal
- ▶E◀ 10. Rocker arms and rocker arm shaft IN
- ▶E◀ 11. Rocker arms and rocker arm shaft EX

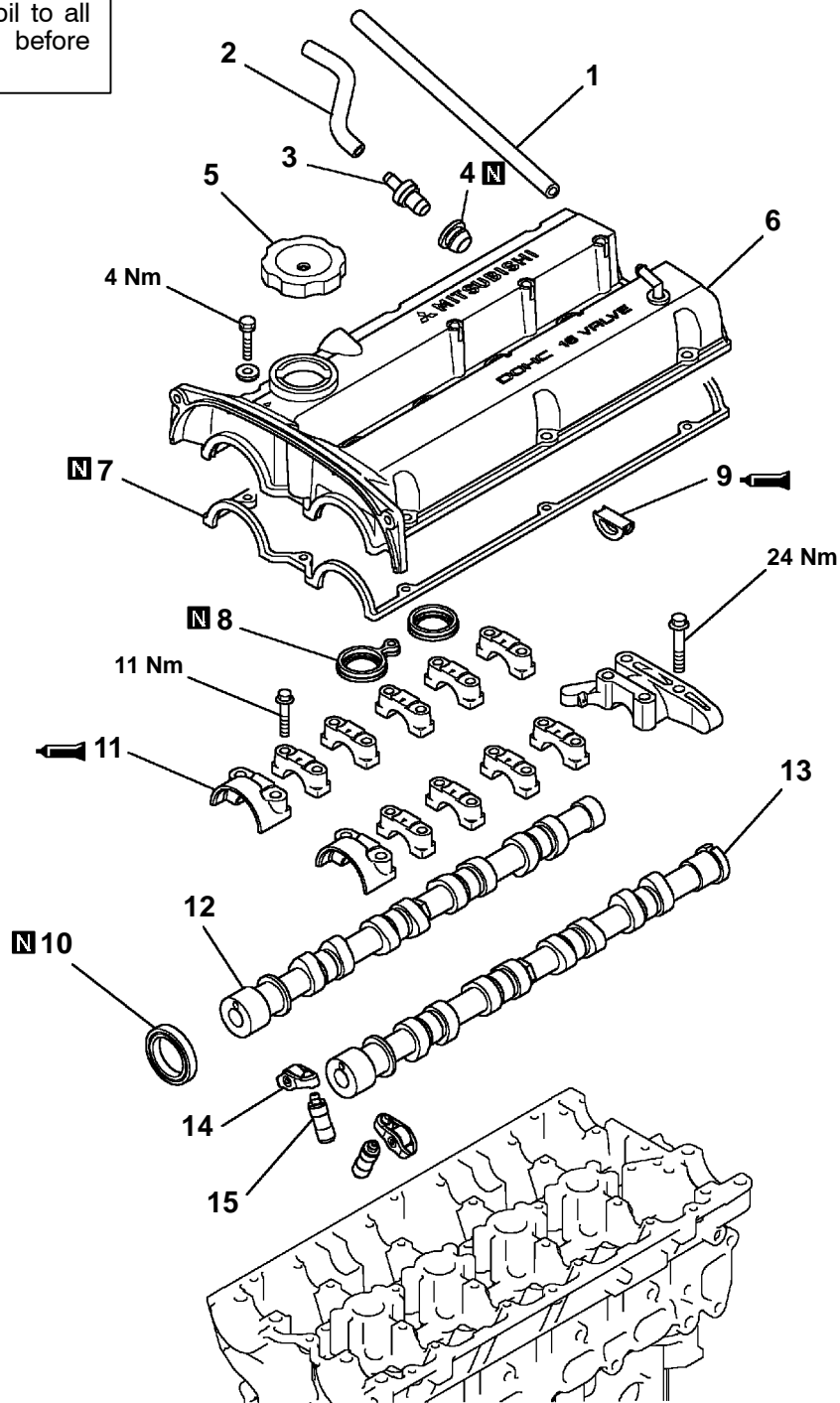
12. Rocker arm B
13. Rocker arm A
- ▶D◀▶C◀ 14. Rocker arm shaft
- ▶D◀▶C◀ 15. Adjusting screw
16. Nut
17. Rocker arm C
- ▶D◀▶C◀ 18. Rocker arm shaft
- ▶D◀▶C◀ 19. Adjusting screw
20. Nut
21. Camshaft

Apply engine oil to all moving parts before installation.

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REMOVAL AND INSTALLATION <DOHC>

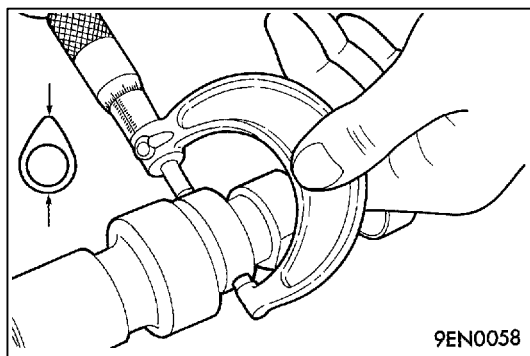
Apply engine oil to all moving parts before installation.



1EN0625

Removal steps

- |                          |                              |
|--------------------------|------------------------------|
| 1. Breather hose         | ▶G◀ 9. Semi-circular packing |
| 2. P.C.V. hose           | ▶F◀ 10. Camshaft oil seal    |
| 3. P.C.V. valve          | ▶B◀ 11. Bearing cap          |
| 4. P.C.V. valve gasket   | ▶A◀ 12. Camshaft             |
| 5. Oil filler cap        | ▶A◀ 13. Camshaft             |
| ▶H◀ 6. Rocker cover      | 14. Roller rocker arm        |
| 7. Rocker cover gasket A | 15. Lash adjuster            |
| 8. Rocker cover gasket B |                              |



## INSPECTION

### 1. CAMSHAFT

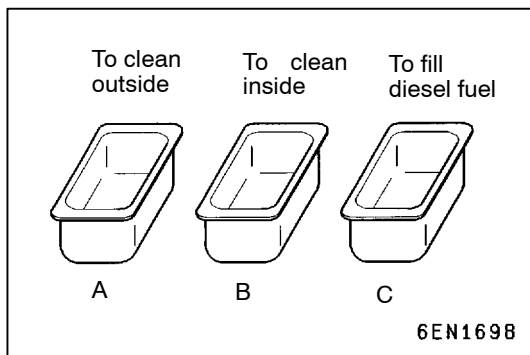
- (1) Measure the cam heights and replace the camshaft if any height exceeds the specified limit.

		Standard value mm	Limit mm
Intake	SOHC 12-VALVE	38.78	38.28
	SOHC 16-VALVE	36.99	36.49
	DOHC	34.67	34.17
Exhaust	SOHC 12-VALVE	39.10	38.60
	SOHC 16-VALVE	36.85	36.35
	DOHC	34.26	33.76

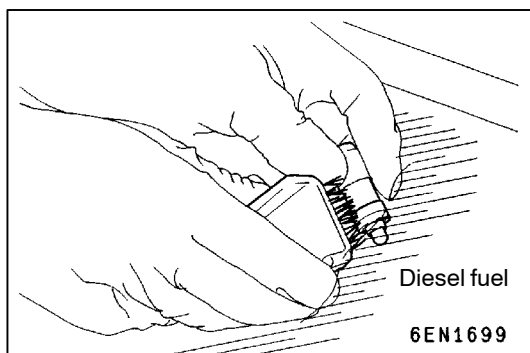
### 2. LASH ADJUSTERS

#### Caution

1. The lash adjusters are precision-engineered mechanisms. Do not allow them to become contaminated by dirt or other foreign substances.
2. Do not attempt to disassemble the lash adjusters.
3. Use only fresh diesel fuel to clean the lash adjusters.



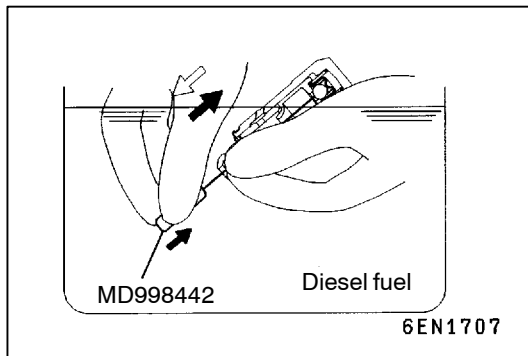
- (1) Prepare three containers and approximately five liters of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.



- (2) Place the lash adjuster in container A and clean its outside surface.

#### NOTE

Use a nylon brush if deposits are hard to remove.



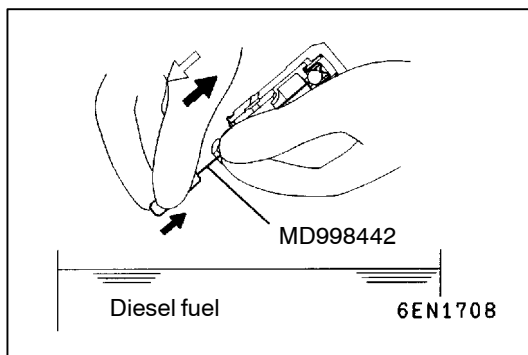
- (3) While gently pushing down the internal steel ball using special tool MD998442, move the plunger through 5 to 10 strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.

**Caution**

The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

**NOTE**

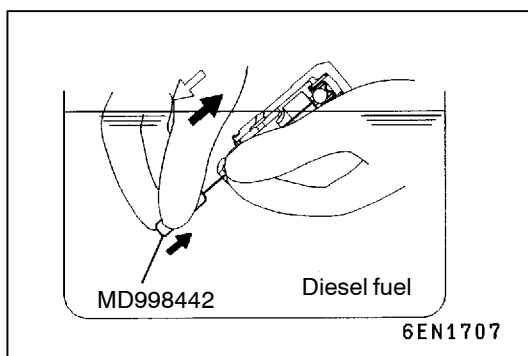
If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.



- (4) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

**Caution**

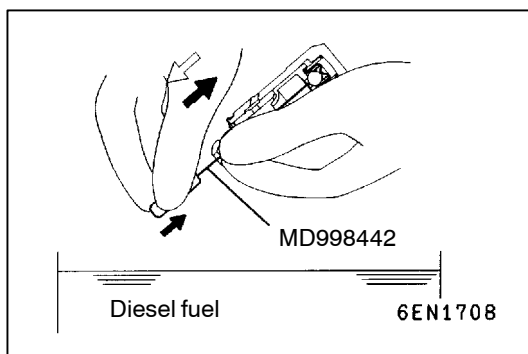
Make sure the oil hole in the side of the body is pointing toward container A. Do not point the oil hole at yourself or other people.



- (5) Place the lash adjuster in container B. Then, gently push down the internal steel ball using special tool MD998442 and move the plunger through 5 to 10 strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.

**Caution**

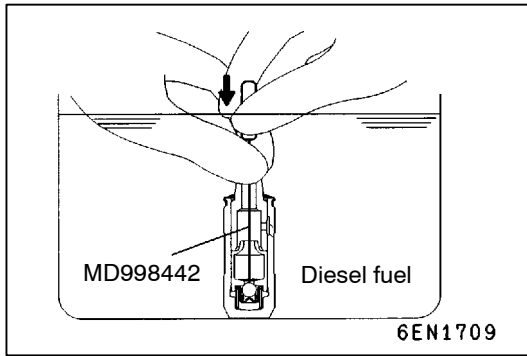
The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.



- (6) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

**Caution**

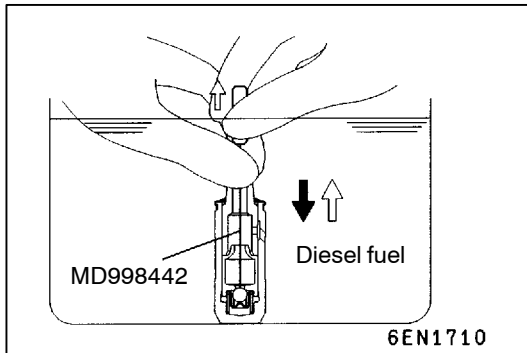
Make sure the oil hole in the side of the body is pointing toward container B. Do not point the oil hole at yourself or other people.



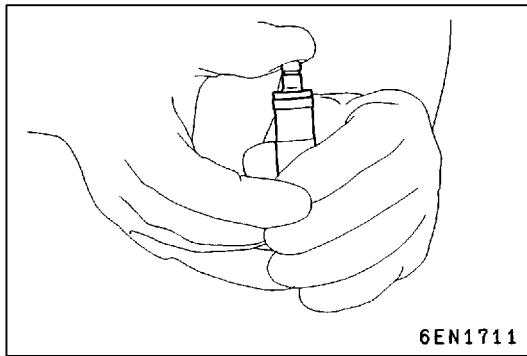
- (7) Place the lash adjuster in container C. Then, gently push down the internal steel ball using special tool MD998442.

#### Caution

Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when chamber is filled with diesel fuel.



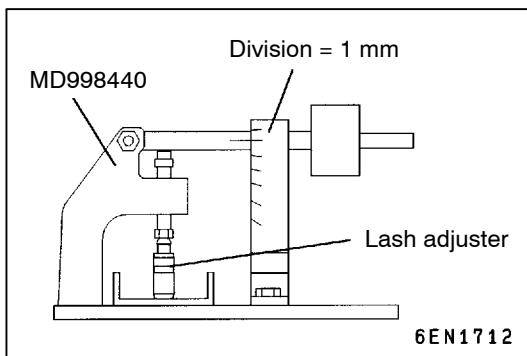
- (8) Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.



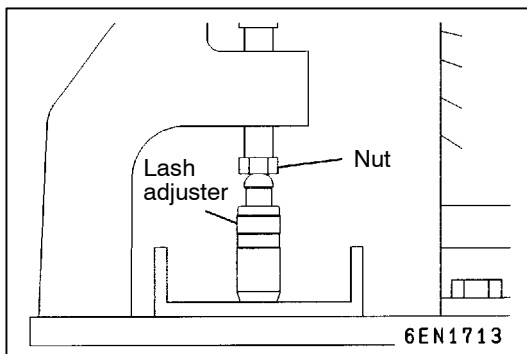
- (9) Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move. Also, check that the lash adjuster's height matches that of a new lash adjuster.

#### NOTE

If lash adjuster contracts, perform the operations (7) through (9) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.



- (10) Set the lash adjuster on the special tool MD998440 (leak down tester).



- (11) Remove the bolt from the tester, then adjust the height as illustrated.

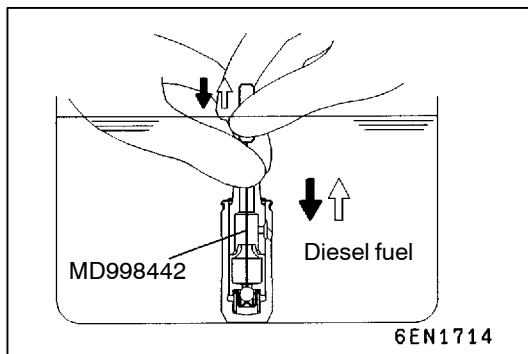
- (12) After the plunger has moved downward slightly (0.2 to 0.5 mm), measure the time taken for it to move downward by a further 1 mm.

#### Standard value:

3 - 20 second/1 mm [with diesel fuel at 15 - 20°C (59 - 68°F)]

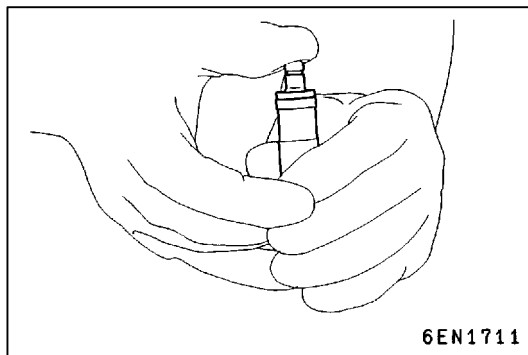
## NOTE

Replace the lash adjuster if the time measurement is out of specification.



(13) Place the lash adjuster in container C again, then gently push down the internal steel ball using special tool MD998442.

(14) Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.

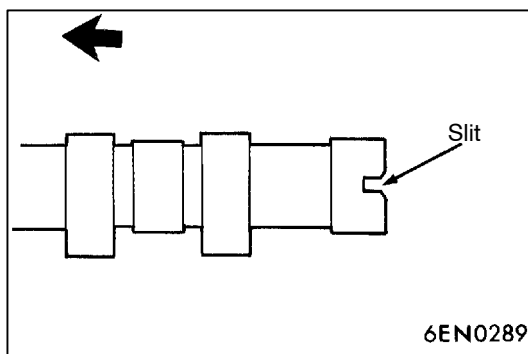


(15) Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move. Also, check the lash adjuster's height matches that of a new lash adjuster.

## NOTE

If lash adjuster contracts, perform the operations (13) through (15) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.

(16) Stand the lash adjuster upright to prevent diesel fuel from spilling out. Do not allow the lash adjuster to become contaminated by dirt or other foreign matter. Fit the lash adjuster onto the engine as soon as possible.



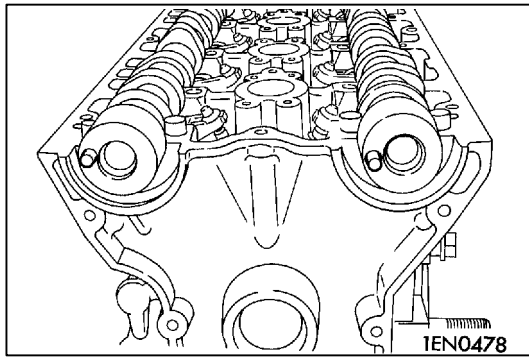
## INSTALLATION SERVICE POINTS

## ▶◀ CAMSHAFT INSTALLATION

(1) Apply engine oil to the camshaft journals and cams before installation. Ensure that the intake-side and exhaust-side camshafts are not reversed.

## NOTE

There is a 4 mm-wide slot in the rear end of the exhaust-side camshaft.

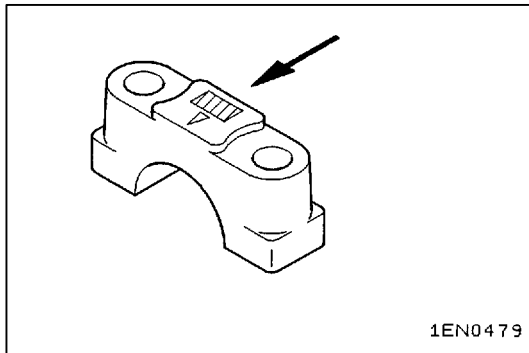


### ►B◄ BEARING CAP INSTALLATION

- (1) Position the camshaft dowel pins as shown.

#### NOTE

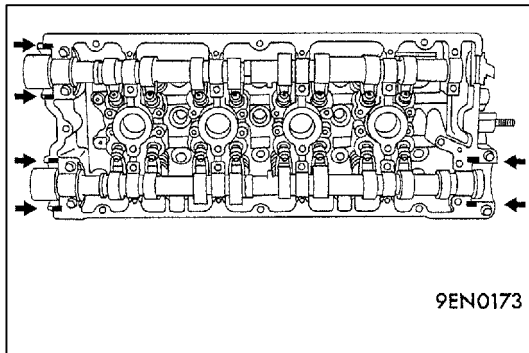
With the camshaft dowel pins in this position, the camshaft notches for tightening cylinder head bolt are correctly positioned.



- (2) Bearing caps Nos. 2 to 5 are the same shape. Be sure to install them in order of their cap numbers and check the identification marks to ensure that the intake and exhaust sides are not reversed.

#### Identification marks:

**I: Intake**  
**E: Exhaust**

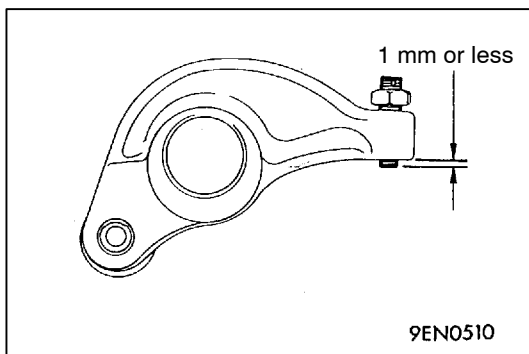


- (3) Apply the specified sealant to the surfaces that are to mate with the cylinder head. Then, tighten the bearing cap bolts - for the middle caps first, then for the outer caps, and soon. Tighten the bolts a little at a time such that each bolt is tightened to the specified torque in the final sequence.

#### Specified sealant:

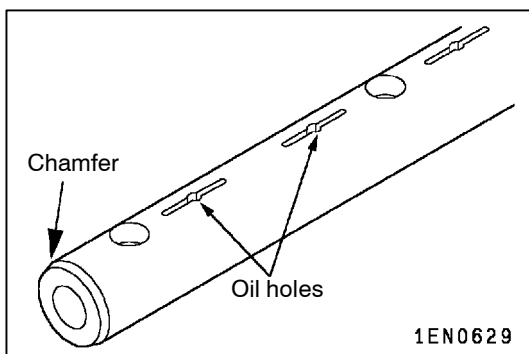
**3M ATD Part No. 8660 or equivalent**

- (4) Check that the rocker arms are installed correctly.



### ►C◄ ADJUSTING SCREW INSTALLATION

- (1) Install provisionally the screw to the rocker arm. Insert it so that the end of the screw is flush with the edge of the rocker arm or projects slightly (1 mm or less).



### ►D◄ ROCKER ARM SHAFT INSTALLATION

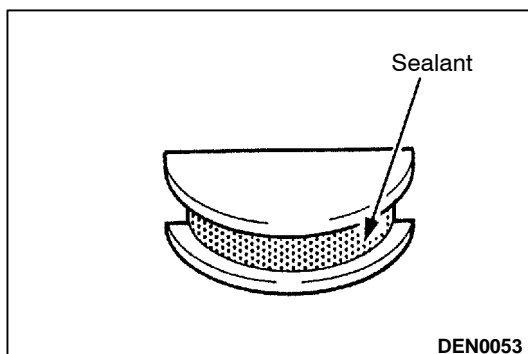
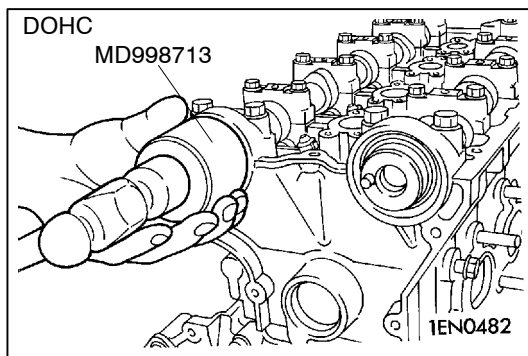
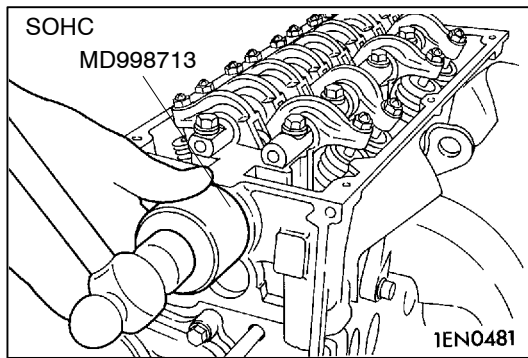
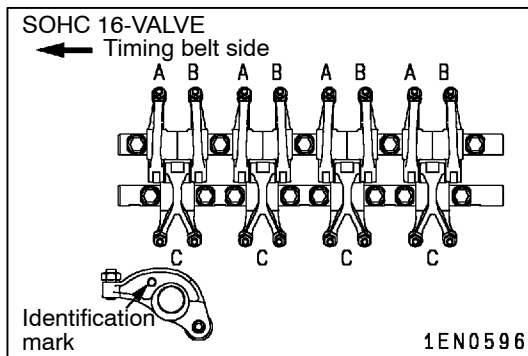
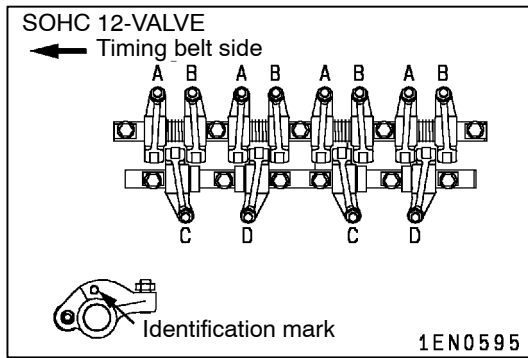
- (1) Place the end with the larger chamfered side toward the flywheel side. <SOHC 12-VALVE>  
Place the end with the larger chamfered side toward the timing belt side. <SOHC 16-VALVE>

#### NOTE

The rocker arm shaft for intake valves have eight oil holes.

- (2) Place the section of the shaft with the oil holes toward the cylinder head.





### ►E◄ ROCKER ARM / ROCKER SHAFT ASSEMBLY INSTALLATION

- (1) Assemble the rocker arms and rocker shaft, paying attention to the identification marks. Then mount the assembly on the cylinder head.

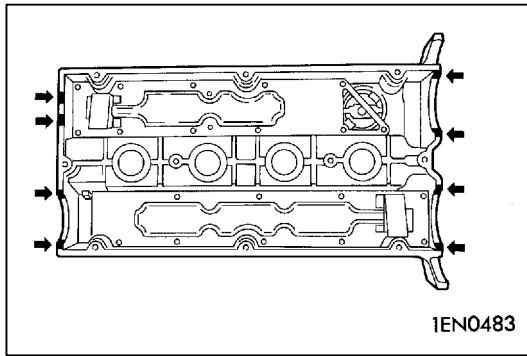
### ►F◄ CAMSHAFT OIL SEAL INSTALLATION

### ►G◄ SEMI-CIRCULAR PACKING INSTALLATION

- (1) Apply the specified sealant to the area shown.

**Specified sealant:**

**3M ATD Part No. 8660 or equivalent**

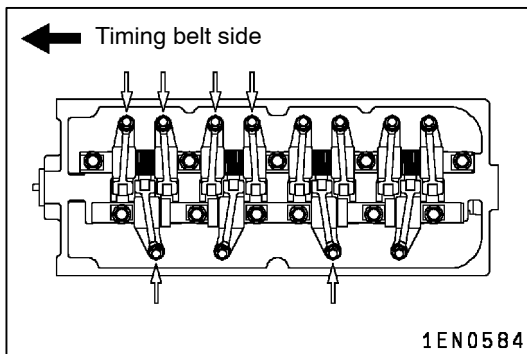


### ►H◀ROCKER COVER INSTALLATION

- (1) Apply the specified sealant to the area shown, then fit the rocker cover.

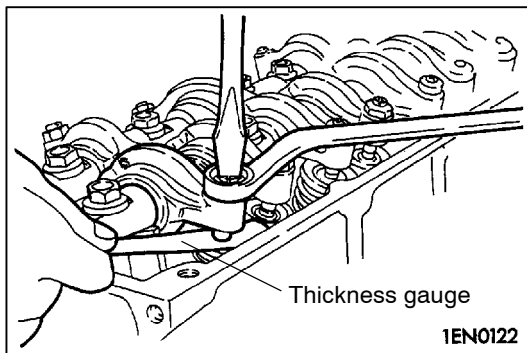
**Specified sealant:**

**3M ATD part No. 8660 or equivalent**



### VALVE CLEARANCE ADJUSTMENT <SOHC 12-VALVE>

- (1) Position the No. 1 cylinder at top dead center on the compression stroke.
- (2) Adjust the valve clearance at the points shown in the illustration.



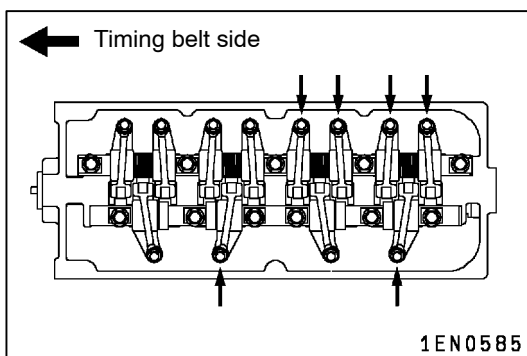
- (3) Loosen the adjusting screw locknut.
- (4) Using a feeler gauge, adjust the valve clearance by turning the adjusting screw.

**Standard value: on cold engine**

**Intake 0.09 mm**

**Exhaust 0.17 mm**

- (5) While holding the adjusting screw with a screwdriver, tighten the lock nut.

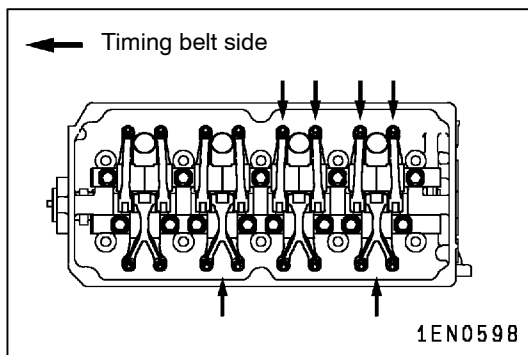
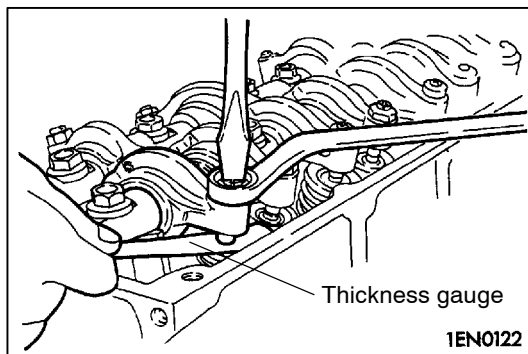
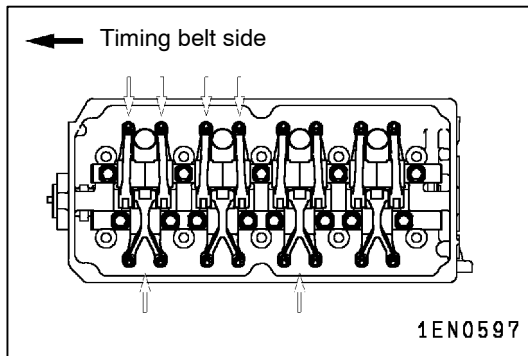


- (6) Rotate clockwise the crankshaft one complete turn (360° degree).
- (7) Adjust the valve clearance at points as shown in the illustration.
- (8) Repeat steps (3) to (5) to adjust the valve clearance of remaining valves.
- (9) With the engine mounted on vehicle, warm up the engine. Then, check for valve clearance on hot engine and adjust if necessary.

**Standard value: on hot engine**

**Intake 0.20 mm**

**Exhaust 0.25 mm**



### <SOHC 16-VALVE>

- (1) Position the No. 1 cylinder at top dead center on the compression stroke.
- (2) Adjust the valve clearance at the points shown in the illustration.

- (3) Loosen the adjusting screw locknut.
- (4) Using a feeler gauge, adjust the valve clearance by turning the adjusting screw.

#### Standard value: on cold engine

Intake 0.09 mm

Exhaust 0.17 mm

- (5) While holding the adjusting screw with a screwdriver, tighten the lock nut.

- (6) Rotate clockwise the crankshaft one complete turn (360° degree).
- (7) Adjust the valve clearance at points as shown in the illustration.
- (8) Repeat steps (3) to (5) to adjust the valve clearance of remaining valves.
- (9) With the engine mounted on vehicle, warm up the engine. Then, check for valve clearance on hot engine and adjust if necessary.

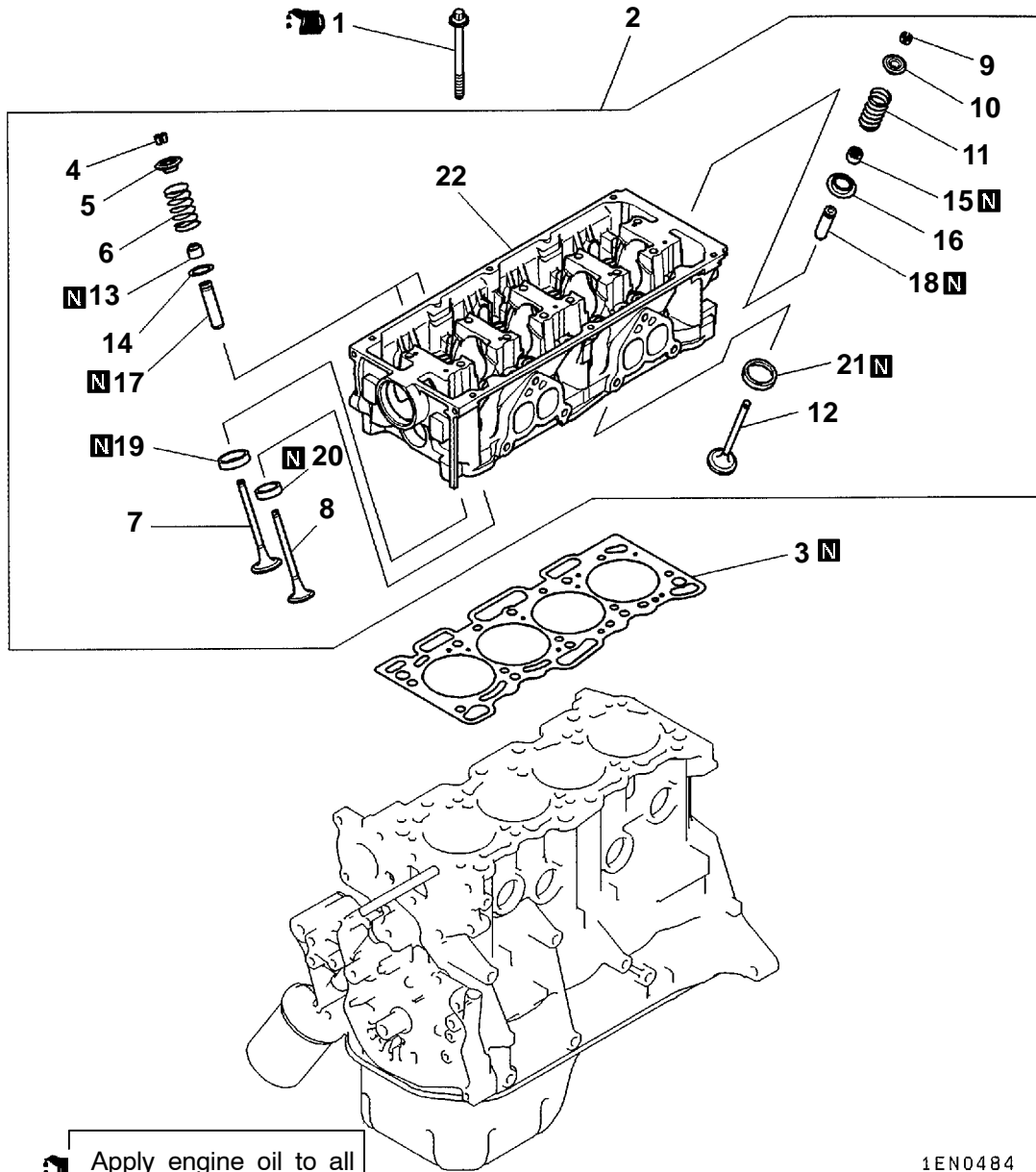
#### Standard value: on hot engine

Intake 0.20 mm

Exhaust 0.25 mm

# 9. CYLINDER HEAD AND VALVES

## REMOVAL AND INSTALLATION <SOHC 12-VALVE>



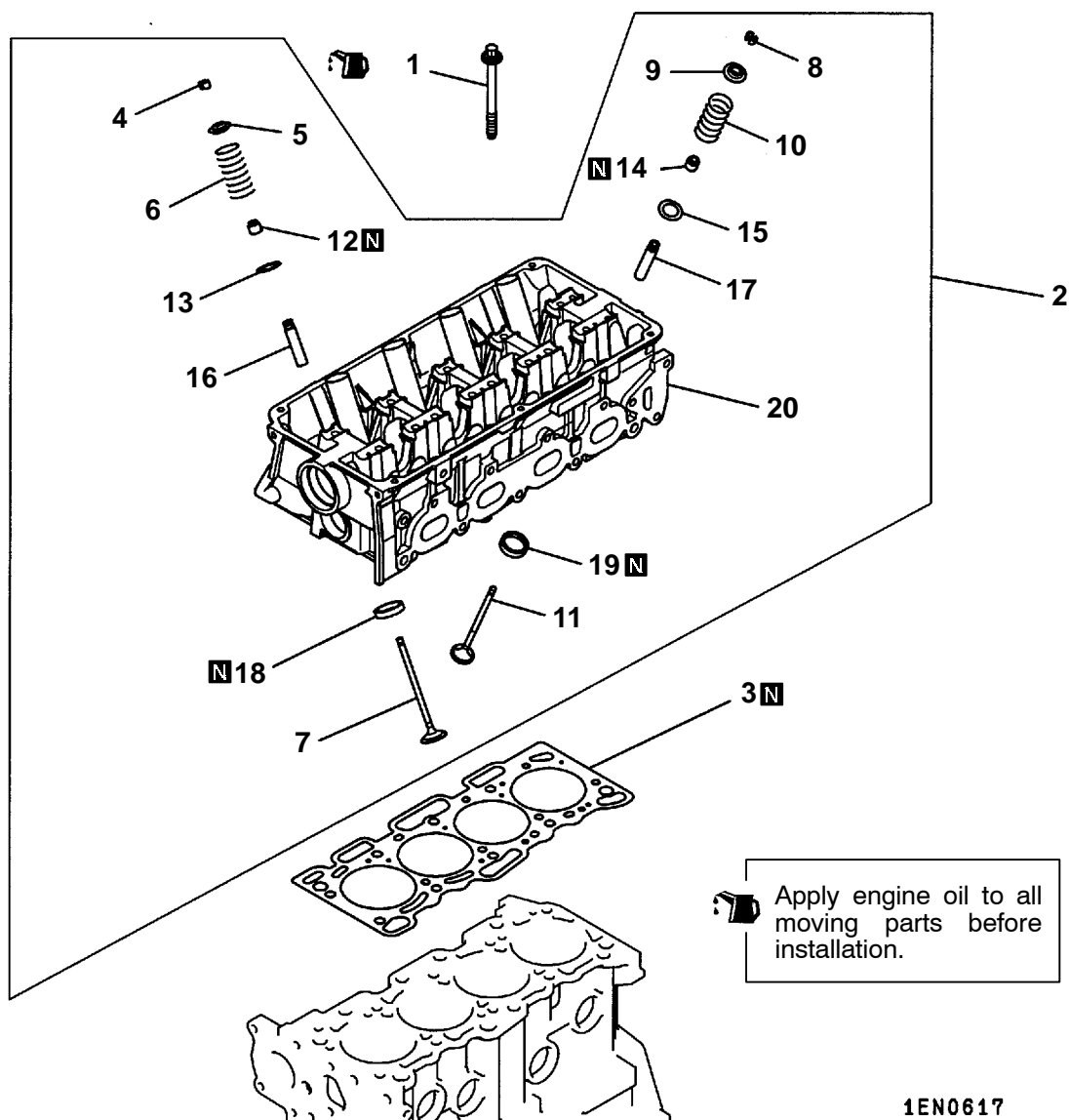
Apply engine oil to all moving parts before installation.

1EN0484

### Removal steps

- |         |                             |         |                                   |
|---------|-----------------------------|---------|-----------------------------------|
| ◀A▶ ▶D▶ | 1. Cylinder head bolt       | ▶C▶ ▶A▶ | 12. Exhaust valve                 |
|         | 2. Cylinder head assembly   |         | 13. Valve stem seal               |
|         | 3. Cylinder head gasket     | ▶C▶ ▶A▶ | 14. Valve spring seat             |
| ◀B▶ ▶C▶ | 4. Retainer lock            |         | 15. Valve stem seal               |
|         | 5. Valve spring retainer    |         | 16. Valve spring seat             |
| ▶B▶     | 6. Valve spring             |         | 17. Intake valve guide            |
|         | 7. Intake valve (primary)   |         | 18. Exhaust valve guide           |
|         | 8. Intake valve (secondary) |         | 19. Intake valve seat (primary)   |
| ◀B▶ ▶C▶ | 9. Retainer lock            |         | 20. Intake valve seat (secondary) |
|         | 10. Valve spring retainer   |         | 21. Exhaust valve seat            |
| ▶B▶     | 11. Valve spring            |         | 22. Cylinder head                 |

REMOVAL AND INSTALLATION <SOHC 16-VALVE>



1EN0617

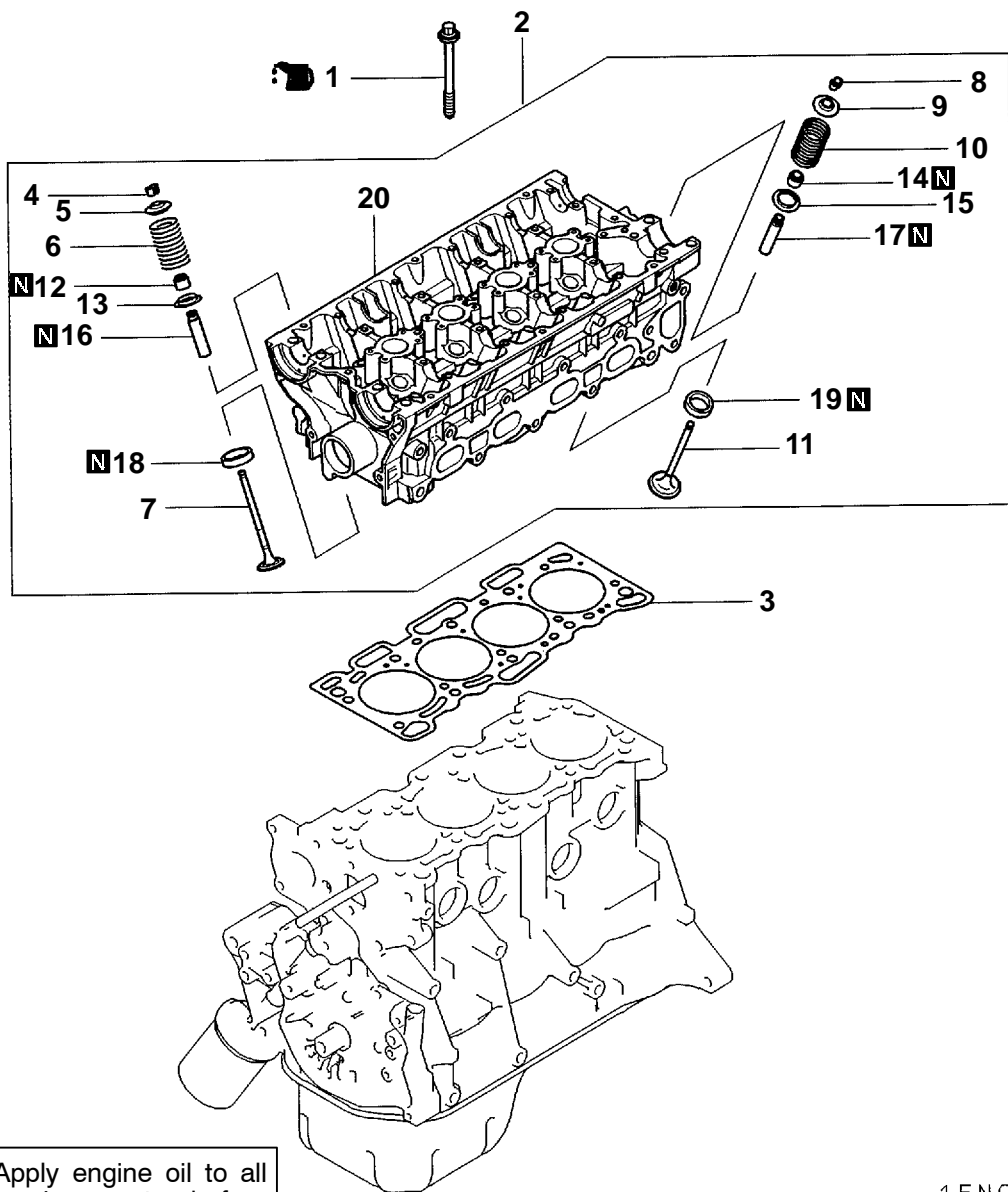
Removal steps

- ◀A▶ ▶D▶ 1. Cylinder head bolt
- ◀B▶ ▶C▶ 2. Cylinder head assembly
- ◀B▶ ▶C▶ 3. Cylinder head gasket
- ▶A▶ ▶D▶ 4. Retainer lock
- ▶B▶ ▶C▶ 5. Valve spring retainer
- ▶B▶ ▶C▶ 6. Valve spring
- ▶B▶ ▶C▶ 7. Exhaust valve
- ▶B▶ ▶C▶ 8. Retainer lock
- ▶B▶ ▶C▶ 9. Valve spring retainer
- ▶B▶ ▶C▶ 10. Valve spring

- ▶C▶ ▶A▶ 11. Intake valve
- ▶C▶ ▶A▶ 12. Valve stem seal
- ▶C▶ ▶A▶ 13. Valve spring seat
- ▶C▶ ▶A▶ 14. Valve stem seal
- ▶C▶ ▶A▶ 15. Valve spring seat
- ▶C▶ ▶A▶ 16. Exhaust valve guide
- ▶C▶ ▶A▶ 17. Intake valve guide
- ▶C▶ ▶A▶ 18. Exhaust valve seat
- ▶C▶ ▶A▶ 19. Intake valve seat
- ▶C▶ ▶A▶ 20. Cylinder head

Intentionally blank

REMOVAL AND INSTALLATION <DOHC>



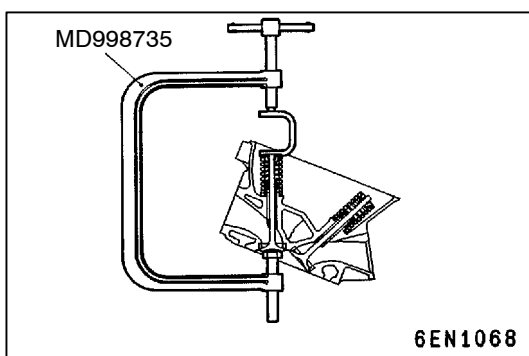
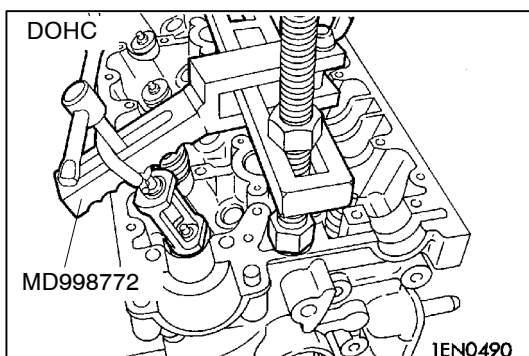
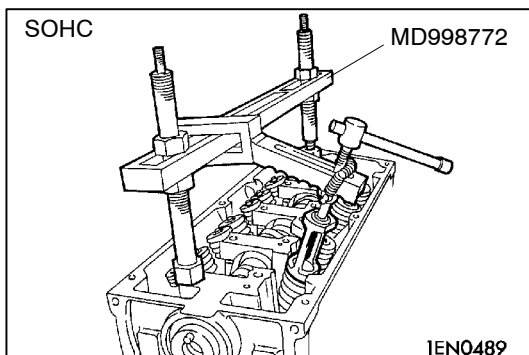
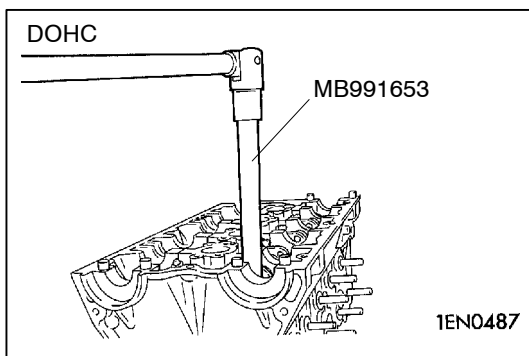
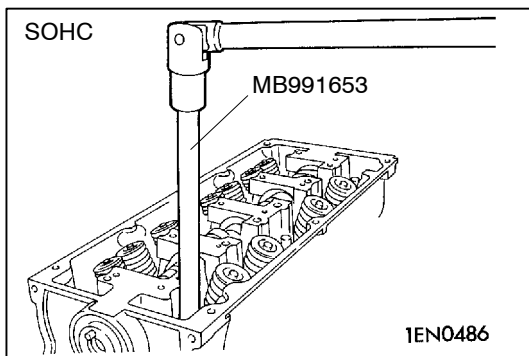
Apply engine oil to all moving parts before installation.

1EN0485

Removal steps

- ◀A▶ ▶D▶ 1. Cylinder head bolt
- ▶B▶ ▶C▶ 2. Cylinder head assembly
- ▶B▶ ▶C▶ 3. Cylinder head gasket
- ▶B▶ ▶C▶ 4. Retainer lock
- ▶B▶ ▶C▶ 5. Valve spring retainer
- ▶B▶ ▶C▶ 6. Valve spring
- ▶B▶ ▶C▶ 7. Intake valve
- ▶B▶ ▶C▶ 8. Retainer lock
- ▶B▶ ▶C▶ 9. Valve spring retainer
- ▶B▶ ▶C▶ 10. Valve spring

- ▶C▶ ▶A▶ 11. Exhaust valve
- ▶C▶ ▶A▶ 12. Valve stem seal
- ▶C▶ ▶A▶ 13. Valve spring seat
- ▶C▶ ▶A▶ 14. Valve stem seal
- ▶C▶ ▶A▶ 15. Valve spring seat
- ▶C▶ ▶A▶ 16. Intake valve guide
- ▶C▶ ▶A▶ 17. Exhaust valve guide
- ▶C▶ ▶A▶ 18. Intake valve seat
- ▶C▶ ▶A▶ 19. Exhaust valve seat
- ▶C▶ ▶A▶ 20. Cylinder head



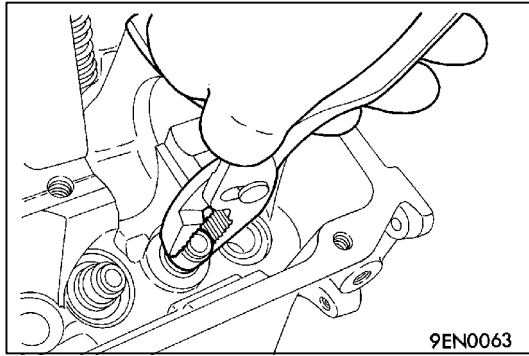
**REMOVAL SERVICE POINTS**

**◀A▶ CYLINDER HEAD BOLT REMOVAL**

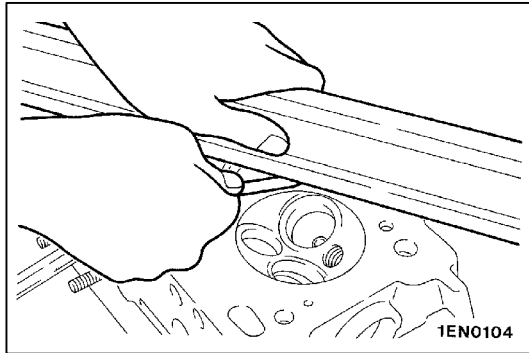
**◀B▶ RETAINER LOCK REMOVAL**

- (1) Tag removed valves, springs, and other components, noting their cylinder numbers and locations to facilitate reassembly. Store these components safely.





## ◀▶ VALVE STEM SEAL REMOVAL



## INSPECTION

### 1. CYLINDER HEAD

- (1) Before cleaning the cylinder head, check it for water leaks, gas leaks, cracks, and other damage.
- (2) Remove all oil, water scale, sealant, and carbon. After cleaning the oil passages, blow air through them to verify that they are not blocked.
- (3) Check for distortion in the cylinder head gasket surface using a straight edge and thickness gauge. If distortion exceeds the specified limit, grind the gasket surface to specification.

#### Gasket surface distortion

**Standard value: 0.05 mm or less**

**Limit: 0.2 mm**

**Grinding limit: 0.2 mm**

**Cylinder head height (specification when new):**

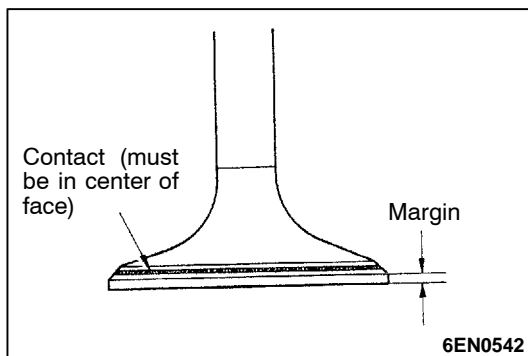
**SOHC 12-VALVE: 106.9 - 107.1 mm**

**SOHC 16-VALVE: 119.9 - 120.1 mm**

**DOHC: 131.9 - 132.1 mm**

#### Caution

**No more than 0.2 mm of stock may be removed from the cylinder head and cylinder block mating surfaces in total.**



### 2. VALVES

- (1) Check the valve face for correct contact. If contact is uneven or incomplete, reface the valve seat.
- (2) If the margin is less than specified, replace the valve.

**Standard value:**

**Intake: 1.0 mm**

**Exhaust: 1.5 mm**

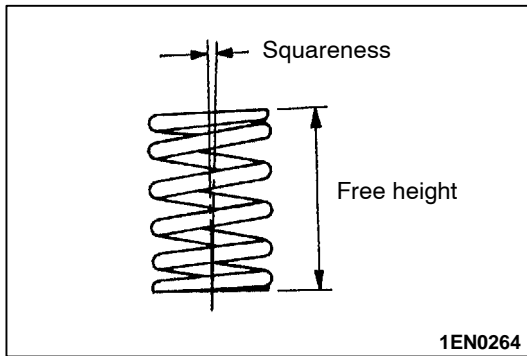
**Limit:**

**Intake: 0.5 mm**

**Exhaust: 1.0 mm**

- (3) Measure the valve's total length. If the measurement is less than specified, replace the valve.

		Standard mm	Limit mm
Intake	SOHC 12-VALVE	100.75	100.25
	SOHC 16-VALVE	111.56	111.06
	DOHC	106.35	105.85
Exhaust	SOHC 12-VALVE	101.05	100.55
	SOHC 16-VALVE	114.71	114.21
	DOHC	106.85	106.35



### 3. VALVE SPRINGS

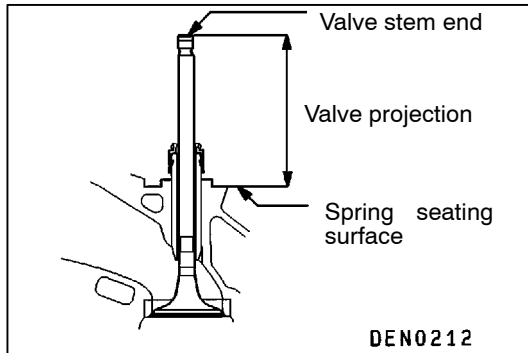
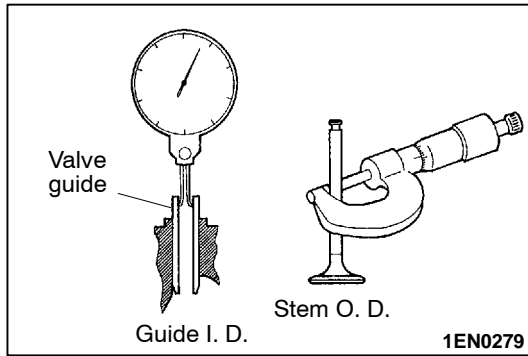
- (1) Measure the valve spring's free height. If the measurement is less than specified, replace the spring.

		Standard mm	Limit mm
SOHC 12-VALVE	Intake	46.1	45.6
	Exhaust	46.8	46.3
SOHC 16-VALVE		50.9	50.4
DOHC		49.1	48.6

- (2) Measure the squareness of the spring. If the measurement exceeds the specified limit, replace the spring.

**Standard value: 2° or less**

**Limit: 4°**



#### 4. VALVE GUIDES

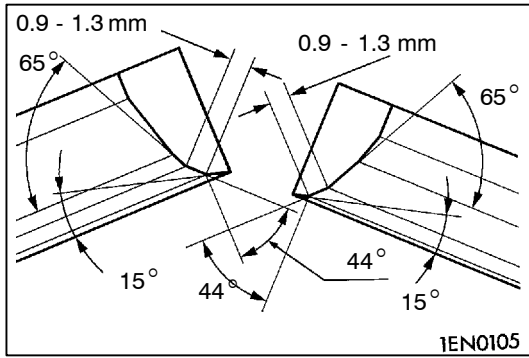
- (1) Measure the clearance between the valve guide and valve stem. If the clearance exceeds the specified limit, replace either or both components.

		Standard mm	Limit mm
Intake	SOHC 12-VALVE	0.020 - 0.050	0.10
	SOHC 16-VALVE	0.020 - 0.047	0.10
	DOHC	0.020 - 0.047	0.10
Exhaust	SOHC 12-VALVE	0.050 - 0.085	0.15
	SOHC 16-VALVE	0.030 - 0.062	0.15
	DOHC	0.030 - 0.057	0.15

#### 5. VALVE SEATS

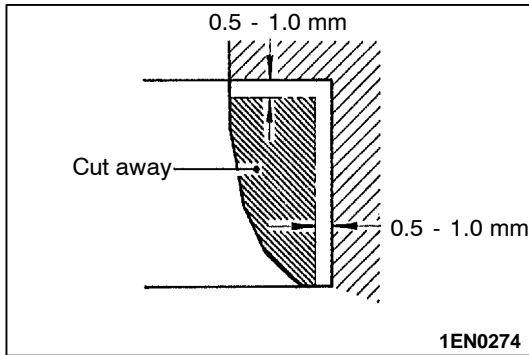
- (1) Assemble the valve, then measure the valve stem projection between the end of the valve stem and the spring seating surface. If the measurement exceeds the specified limit, replace the valve seat.

		Standard mm	Limit mm
SOHC 12-VALVE	Intake	43.70	44.20
	Exhaust	43.30	43.80
SOHC 16-VALVE	Intake	53.21	53.71
	Exhaust	54.10	54.60
DOHC	Intake	48.80	49.30
	Exhaust	48.70	49.20



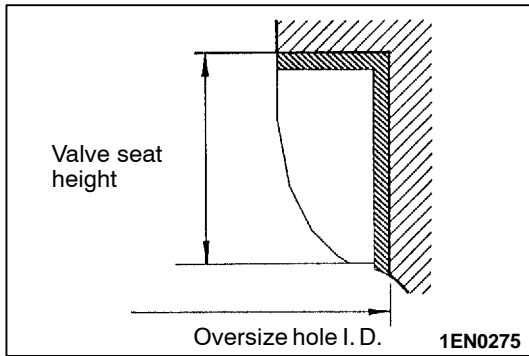
**VALVE SEAT CORRECTION SERVICE POINTS**

- (1) Before correcting the valve seat, check the clearance between the valve guide and valve. If necessary, replace the valve guide.
- (2) Using the appropriate special tool or seat grinder, correct the valve seat to achieve the specified seat width and angle.
- (3) After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection (refer to 5. VALVE SEATS in INSPECTION).



**VALVE SEAT REPLACEMENT SERVICE POINTS**

- (1) Cut the valve seat to be replaced from the inside to reduce the wall thickness. Then, remove the valve seat.
- (2) Rebore the valve seat hole in the cylinder head to match the selected oversize valve seat diameter.



**Valve seat diameters**

				Standard mm
SOHC 12-VALVE	In- take	Primary	0.30 O.S.	27.300 - 27.325
			0.60 O.S.	27.000 - 27.625
		Secondary	0.30 O.S.	32.300 - 32.325
			0.60 O.S.	32.600 - 32.625
	Exhaust	0.30 O.S.	35.300 - 35.325	
		0.60 O.S.	35.600 - 35.625	
SOHC 16-VALVE <4G13>	Intake	0.30 O.S.	28.300 - 28.321	
		0.60 O.S.	28.600 - 28.621	
	Exhaust	0.30 O.S.	26.300 - 26.321	
		0.60 O.S.	26.600 - 26.621	
SOHC 16-VALVE <4G18>	Intake	0.30 O.S.	30.300 - 30.321	
		0.60 O.S.	30.600 - 30.621	
	Exhaust	0.30 O.S.	28.300 - 28.321	
		0.60 O.S.	28.600 - 28.621	
DOHC	Intake	0.30 O.S.	31.300 - 31.325	
		0.60 O.S.	31.600 - 31.625	
	Exhaust	0.30 O.S.	27.800 - 27.825	
		0.60 O.S.	28.100 - 28.125	

- (3) Prevent galling of the cylinder head bore by cooling the valve seat with liquid nitrogen before press-fitting it.
- (4) Correct the valve seat to achieve the specified width and angle (refer to VALVE SEAT CORRECTION SERVICE POINTS).

## VALVE GUIDE REPLACEMENT SERVICE POINTS

- (1) Using a press, push the valve guide out toward the cylinder block side.
- (2) Rebore the valve guide hole in the cylinder head to match the oversize valve guide that is to be fitted.

### Caution

Do not install a valve guide of the same size again.

### Valve guide hole diameters (SOHC 12-VALVE)

0.05 O.S.: 12.050 - 12.068 mm

0.25 O.S.: 12.250 - 12.268 mm

0.50 O.S.: 12.500 - 12.518 mm

### Valve guide hole diameters (SOHC 16-VALVE, DOHC)

0.05 O.S.: 10.550 - 10.568 mm

0.25 O.S.: 10.750 - 10.768 mm

0.50 O.S.: 11.000 - 11.018 mm

- (3) Press-fit the valve guide until it projects by the specified amount.

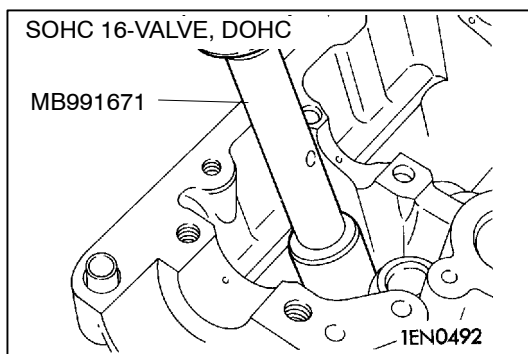
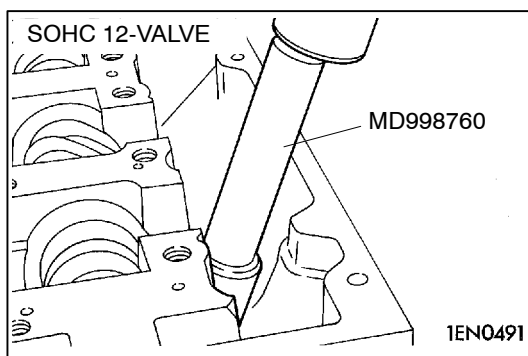
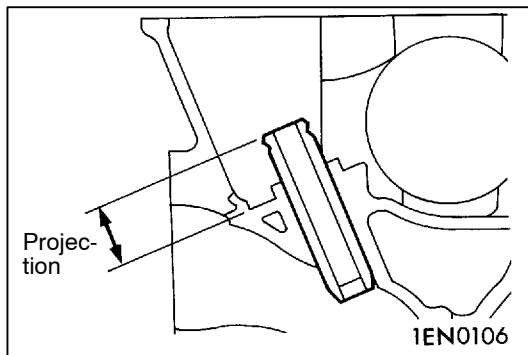
### Standard value:

SOHC 12-VALVE: 17 mm

SOHC 16-VALVE, DOHC: 23 mm

### Caution

1. The valve guide must be installed from the upper side of the cylinder head.
2. The valve guides differ in length on the intake and exhaust sides.
3. After press-fitting the valve guide, insert a new valve and check that it slides smoothly.



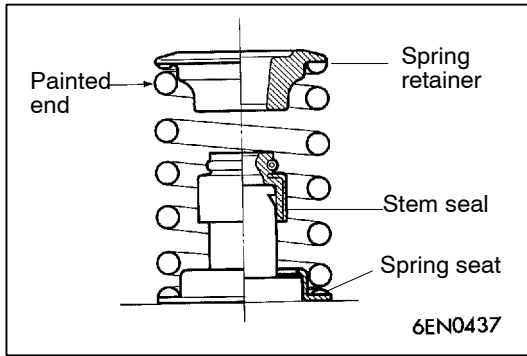
## INSTALLATION SERVICE POINTS

### ▶A◀ VALVE STEM SEAL INSTALLATION

- (1) Install the valve spring seat.
- (2) Install a new valve stem seal using the special tool shown in the illustration.

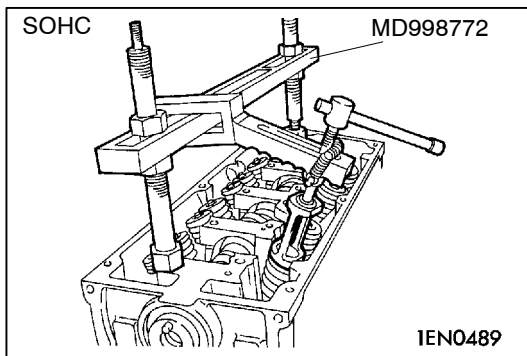
### Caution

1. Valve stem seals cannot be reused.
2. The valve stem seal must be installed using the correct special tool. Incorrect installation could result in oil leaking past the valve guide.

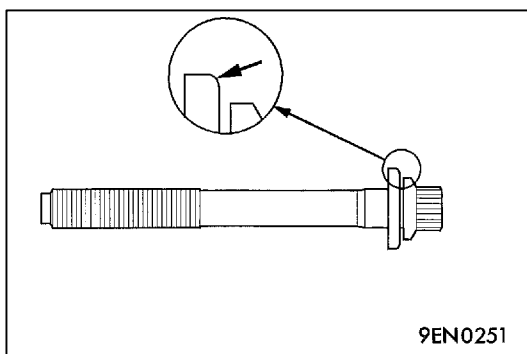
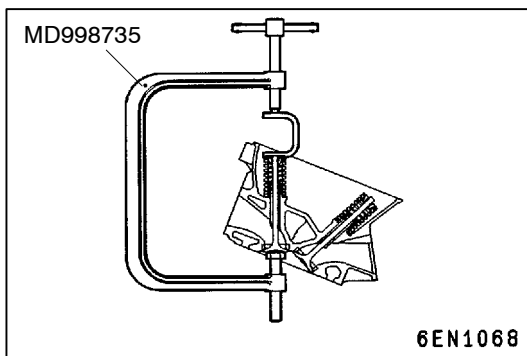
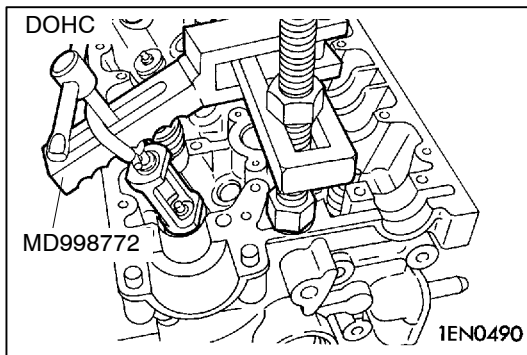


### ►B◄ VALVE SPRING INSTALLATION

- (1) Install the valve spring such that its painted end is on the rocker arm side.



### ►C◄ RETAINER LOCK INSTALLATION

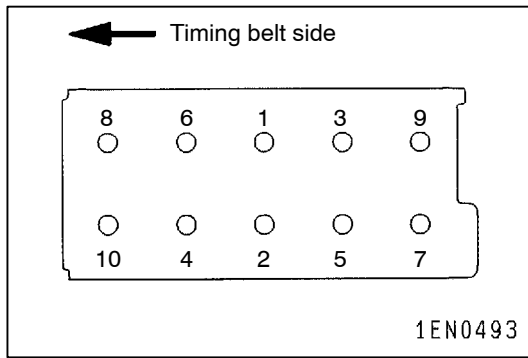


### ►D◄ CYLINDER HEAD BOLT INSTALLATION

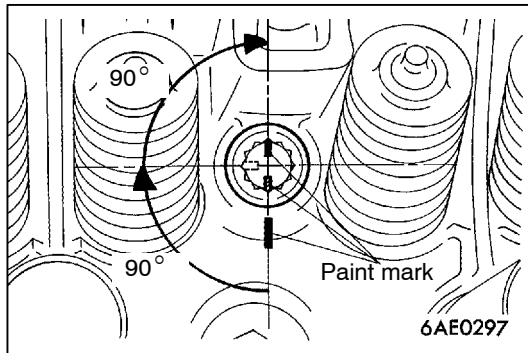
- (1) Before reusing the cylinder head bolt, check that its nominal length does not exceed the specified limit. Replace the bolt if this measurement exceeds the limit.

**Limit: 103.2 mm**

- (2) Fit the washer as shown.
- (3) Apply engine oil to the bolt's thread and washer.



- (4) Tighten the bolts in the sequence shown until each is torqued to 49 Nm.
- (5) Completely loosen the bolts.
- (6) Retighten the bolts in the sequence shown until each is torqued to 20 Nm.



- (7) Apply paint marks to the cylinder head bolt heads and cylinder head as shown.
- (8) In accordance with the tightening sequence, tighten each bolt by 90°.
- (9) Tighten each bolt by a further 90° and check that the paint marks on the bolt head and cylinder head are aligned.


#### Caution

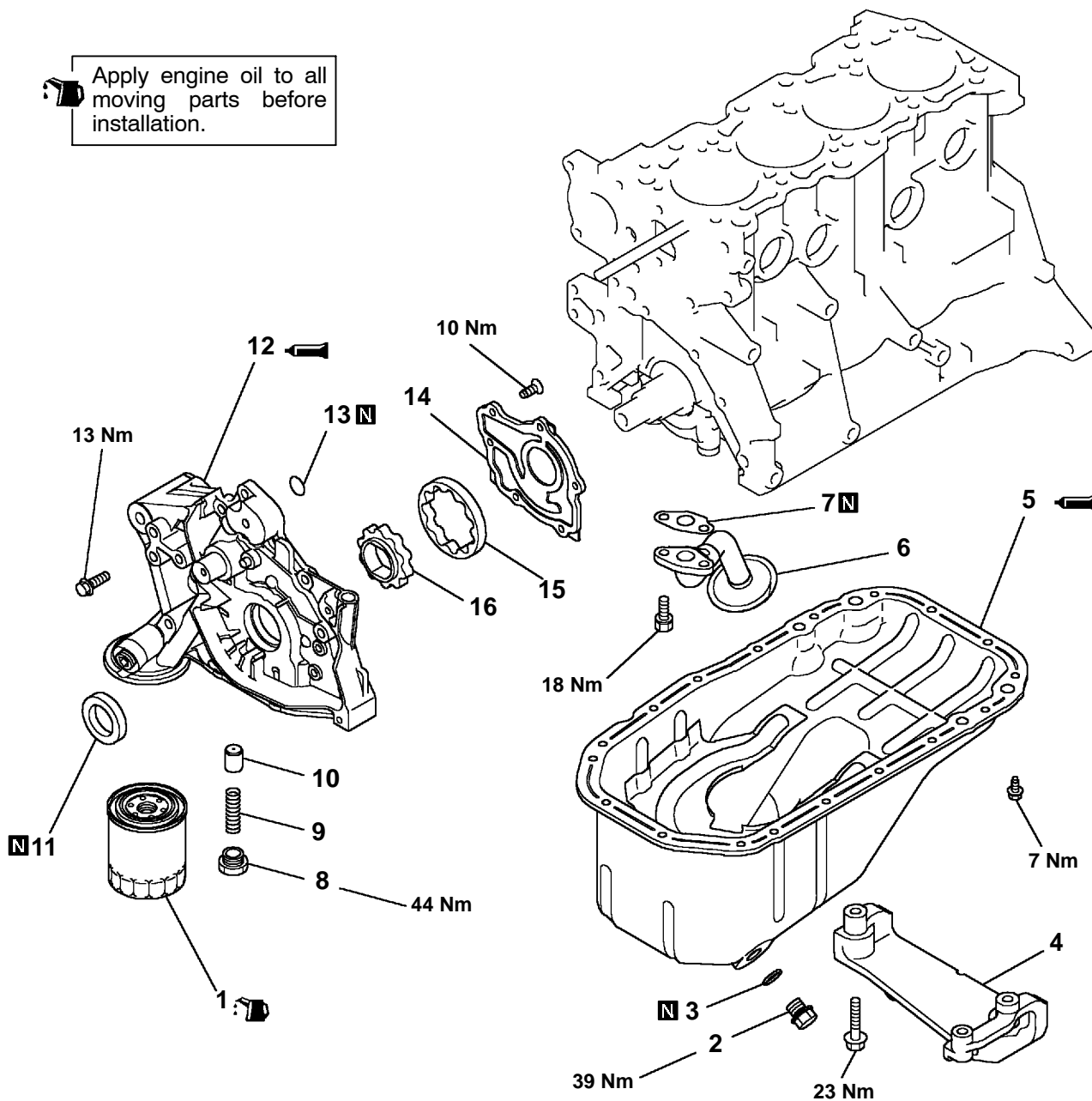
If the bolts are tightened by an angle of less than 90°, they may not hold the cylinder head with sufficient strength.

If the bolts are tightened by an angle exceeding 90°, completely remove them and carry out the installation procedure again.

# 10. OIL PUMP AND OIL PAN

## REMOVAL AND INSTALLATION

 Apply engine oil to all moving parts before installation.



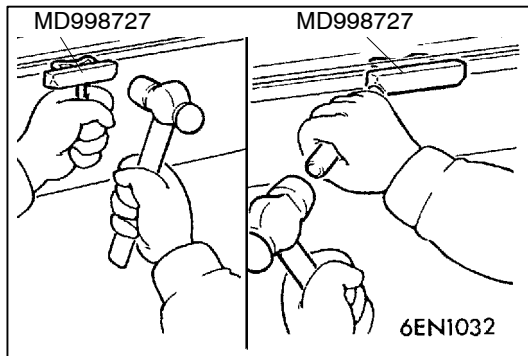
1EN0618

### Removal steps

- E** 1. Oil filter
- D** 2. Drain plug
- D** 3. Gasket
- A** **C** 4. Transmission stay (Rear wheel drive)
- A** **C** 5. Oil pan
- C** 6. Oil screen
- C** 7. Gasket
- C** 8. Relief valve
- C** 9. Relief valve spring

- B** 10. Relief plunger
- B** 11. Front oil seal
- A** 12. Front case
- A** 13. O-ring
- A** 14. Oil pump cover
- A** 15. Oil pump outer rotor
- A** 16. Oil pump inner rotor

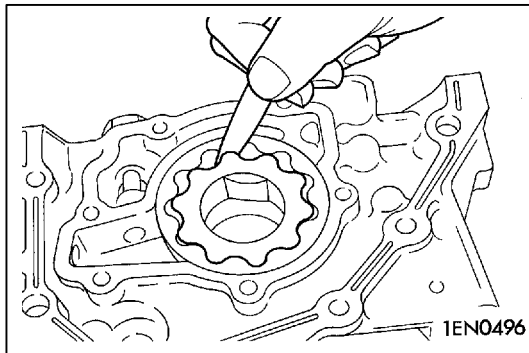




## REMOVAL SERVICE POINTS

### ◀A▶ OIL PAN REMOVAL

- (1) Remove the oil pan mounting bolts.
- (2) Knock the special tool between the oil pan and cylinder block as shown in the illustration.
- (3) Tapping the side of the special tool, slide the tool along the oil pan/cylinder block seal and thus remove the oil pan.

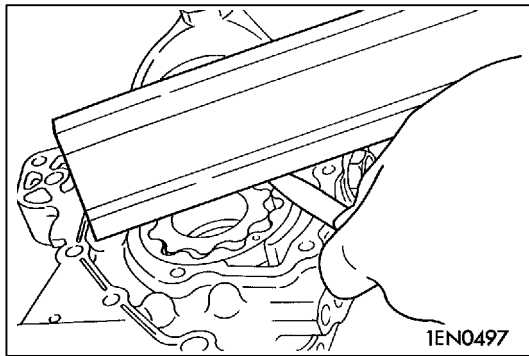


## INSPECTION

### 1. OIL PUMP

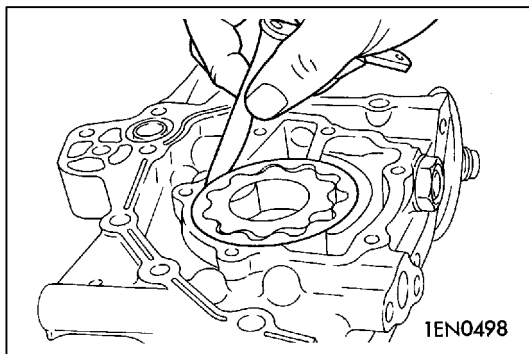
- (1) Fit the rotor into the front case.
- (2) Check the tip clearance using a thickness gauge.

**Standard value: 0.06 - 0.18 mm**



- (3) Check the side clearance using a straight edge and thickness gauge.

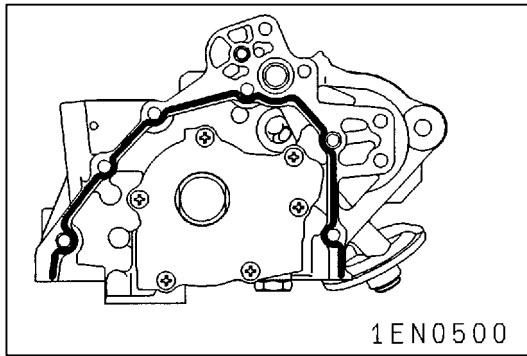
**Standard value: 0.04 - 0.10 mm**



- (4) Check the body clearance using a thickness gauge.

**Standard value: 0.04 - 0.10 mm**

**Limit: 0.35 mm**



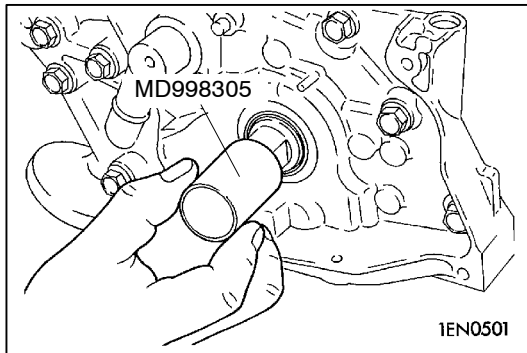
## INSTALLATION SERVICE POINTS

### ▶A◀ FRONT OIL SEAL CASE INSTALLATION

- (1) Clean the sealant application surfaces on the cylinder block and front oil seal case.
- (2) Apply a 3 mm bead of form-in-place gasket to the entire circumference of the oil pan flange.

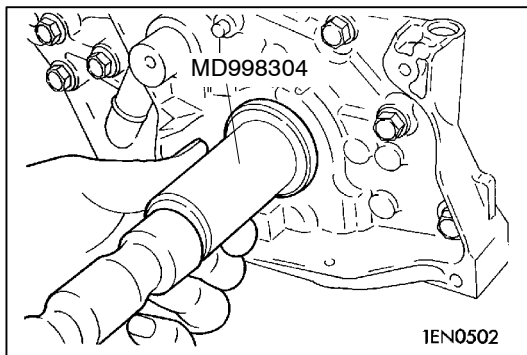
#### Specified sealant:

**Mitsubishi Genuine Part No. MD970389 or equivalent.**

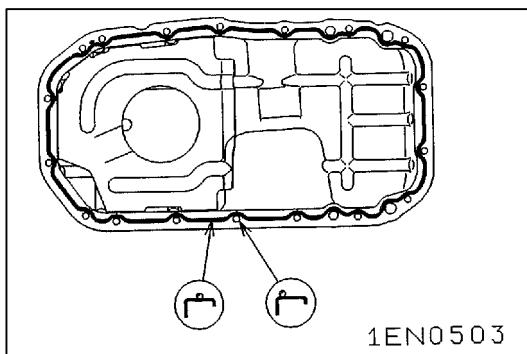


### ▶B◀ FRONT OIL SEAL INSTALLATION

- (1) Place the special tool on the crankshaft's front end and apply engine oil to the its outer circumference.



- (2) Apply engine oil to the oil seal lip, then push the oil seal along the guide by hand until it touches the front case. Tap the oil seal into place using the special tool.

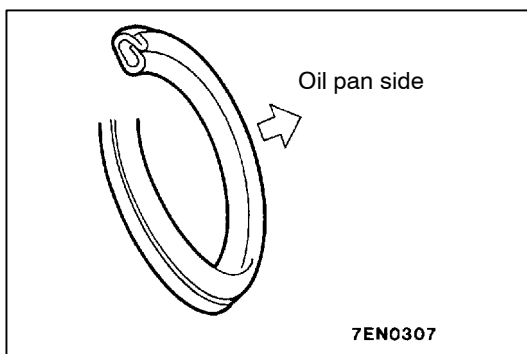


### ▶C◀ OIL PAN INSTALLATION

- (1) Clean the mating surfaces of the cylinder block and oil pan.
- (2) Apply a 4 mm bead of form-in-place gasket to the outer circumference of the oil pan flange.

#### Specified sealant:

**Mitsubishi Genuine Part No. MD970389 or equivalent.**



### ▶D◀ DRAIN PLUG GASKET INSTALLATION

- (1) Replace the drain plug gasket with a new one. Fit the new gasket as shown.

**▶E◀ OIL FILTER INSTALLATION**

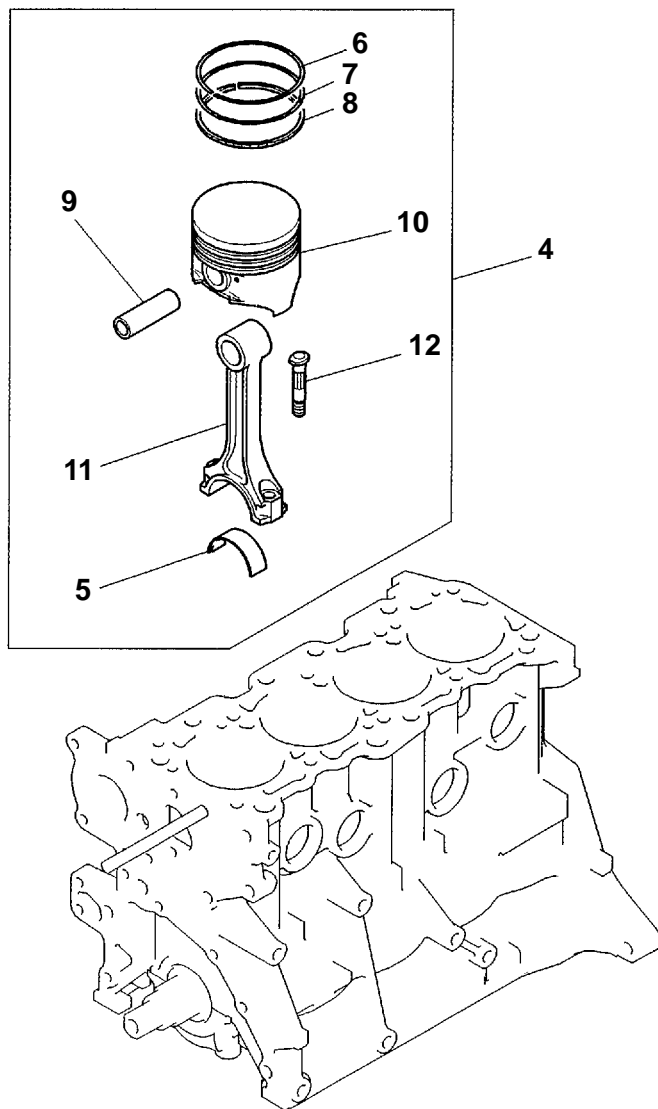
- (1) Clean the filter mounting surface on the front case.
- (2) Apply engine oil to the oil filter's O-ring.
- (3) Screw on the oil filter until the O-ring is seated on the mounting surface. Then, give the oil filter one further turn such that it is torqued to approximately 14 Nm.


**Caution**

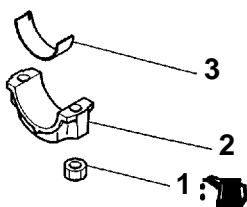
**The oil filter must be tightened using a commercially available filter wrench. If the filter is tightened by hand only, it will be insufficiently torqued, resulting in oil leaks.**

# 11. PISTONS AND CONNECTING RODS

## REMOVAL AND INSTALLATION











 Apply engine oil to all moving parts before installation.

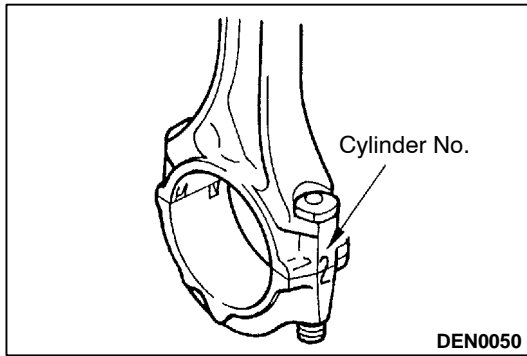


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### Removal steps

- ◀A▶  1. Connecting rod nut
-  2. Connecting rod cap
-  3. Connecting rod bearing
-  4. Piston and connecting rod assembly
-  5. Connecting rod bearing
-  6. Piston ring No. 1

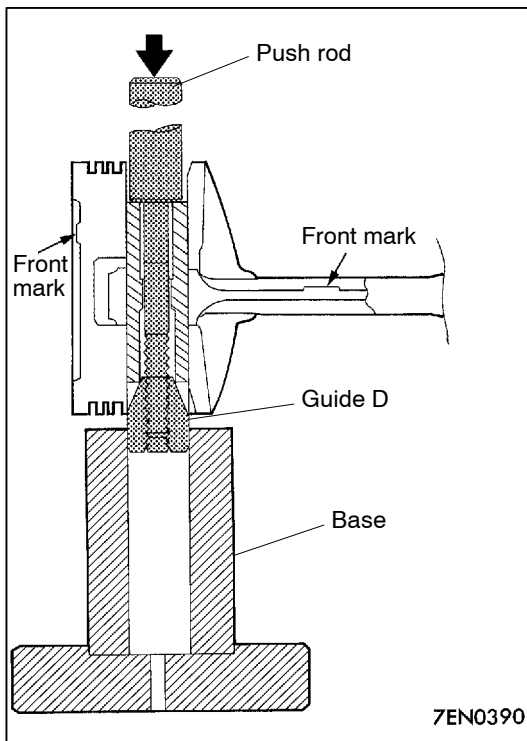
- ▶B▶  7. Piston ring No. 2
-  8. Oil ring
-  9. Piston pin
-  10. Piston
-  11. Connecting rod
-  12. Bolt



## REMOVAL SERVICE POINTS

### ◀A▶ CONNECTING ROD CAP REMOVAL

- (1) Mark the cylinder number on the side of the connecting rod big end to facilitate reassembly.



### ◀B▶ PISTON PIN REMOVAL

- (1) Insert the Push Rod (special tool) from the front arrow mark side, then fit guide D.
- (2) Mount the piston and connecting rod assembly on the Piston Pin Setting Base (special tool) with the piston's front mark pointing upward.
- (3) Remove the piston pin using a press.

#### NOTE

After removing the piston pin, keep the piston, piston pin, and connecting rod together. Do not allow pistons, piston pins, and connecting rods from different cylinders to become mixed up.

## INSPECTION

### 1. PISTON RINGS

- (1) Check the piston ring side clearance. If the clearance exceeds the specified limit, replace the ring or piston, or both.

#### Standard values:

No. 1 ring: 0.03 - 0.07 mm

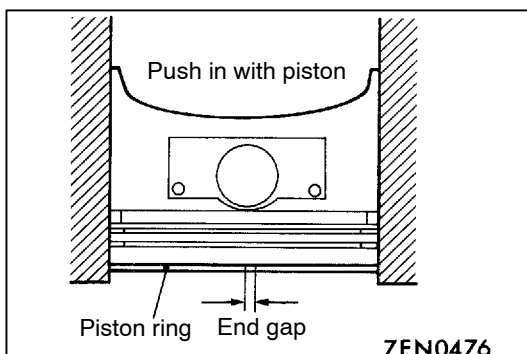
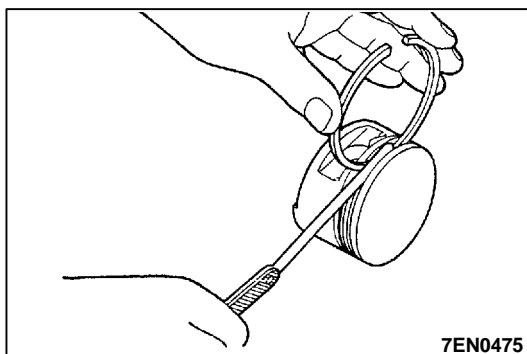
No. 2 ring: 0.02 - 0.06 mm

#### Limits:

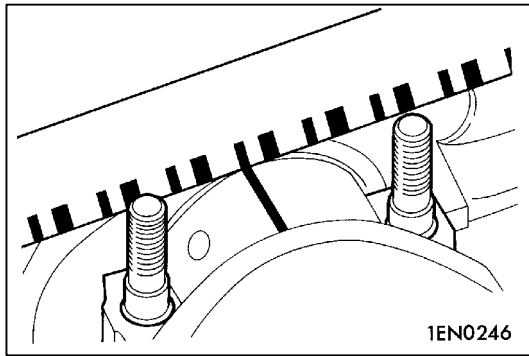
No. 1 ring: 0.1 mm

No. 2 ring: 0.1 mm

- (2) Insert the piston ring into the cylinder bore and push it down with a piston. Ensure that the piston's crown is in contact with the ring such that the ring is at 90° to the cylinder wall. Then, measure the end gap with a thickness gauge. If the gap is too large, replace the piston ring.



		Standard values mm	Limits mm
No. 1 ring		0.20 - 0.35	0.8
No. 2 ring		0.35 - 0.50	0.8
Oil ring	SOHC 12-VALVE, DOHC	0.20 - 0.50	1.0
	SOHC 16-VALVE	0.10 - 0.40	1.0

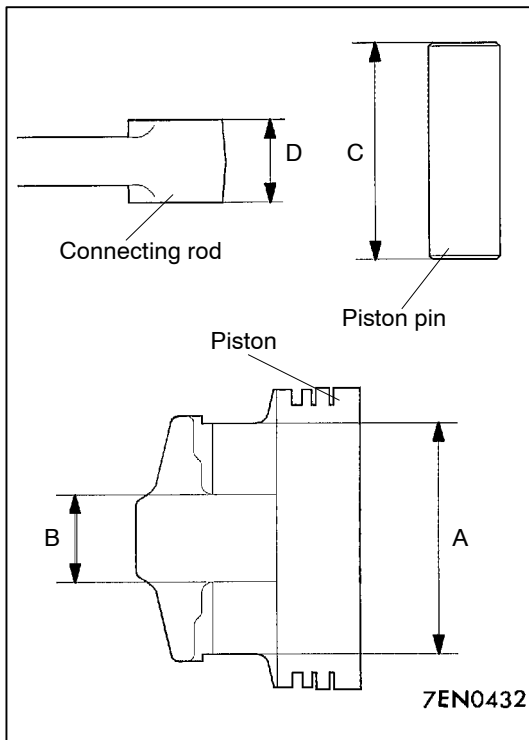


## 2. CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGE METHOD)

- (1) Wipe all oil off the crankshaft pin and connecting rod bearing.
- (2) On the pin, place a plastic gauge that is cut to the same length as the bearing's width. The plastic gauge must be centered on the pin in parallel with the pin's axis.
- (3) Gently place the connecting rod cap in position and tighten the bolts to the specified torque.
- (4) Remove the bolts and gently remove the connecting rod cap.
- (5) Measure the compressed part of the plastic gauge at its widest point using the scale printed on the plastic gauge bag.

**Standard value: 0.02 - 0.04 mm**

**Limit: 0.1 mm**



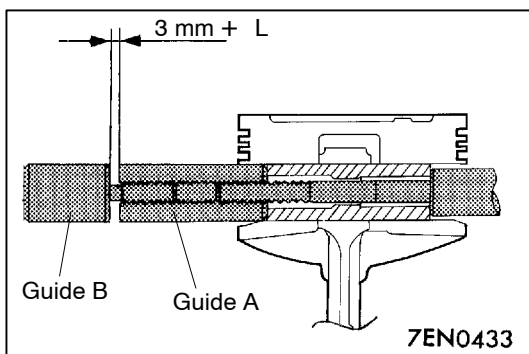
## INSTALLATION SERVICE POINTS

### ▶A◀ PISTON PIN INSTALLATION

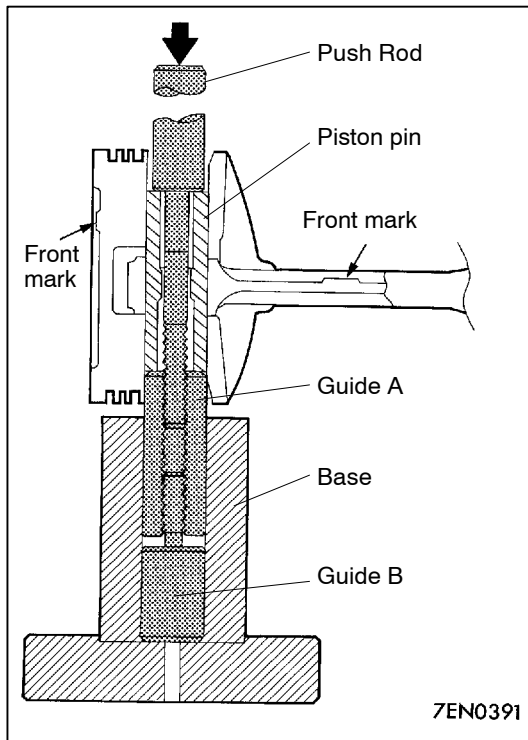
- (1) Measure the following lengths (as shown):  
 A: Piston boss-to-piston boss outside dimension  
 B: Piston boss-to-piston boss inside dimension  
 C: Piston pin length  
 D: Connecting rod small end eye thickness
- (2) Enter the measured values into the following formula:

$$L = \frac{(A - C) - (B - D)}{2}$$

- (3) Insert the Push Rod (special tool) into the piston pin, then fit Guide A (special tool).
- (4) Fit the piston and connecting rod together such that their front marks are on the same side.
- (5) Apply engine oil to the outside of the piston pin.
- (6) Into the front-mark side of the piston, insert the Guide A, piston pin, and Push Rod, starting with guide A.

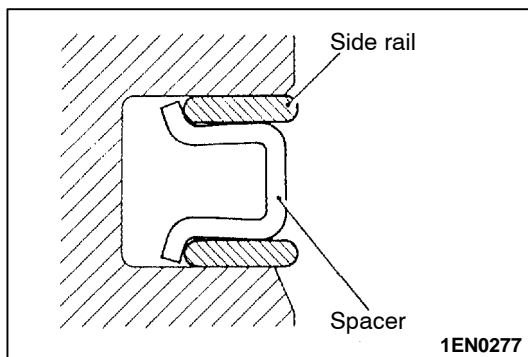


- (7) Screw guide B into guide A. Leave a gap between the two guides of 3 mm plus the value (L) calculated in step (2).



- (8) Mount the piston and connecting rod on the Piston Pin Setting Base (special tool) with the piston's front mark pointing upward.
- (9) Install the piston pin using a press. If the press-fitting load is out of specification, replace the piston pin and piston assembly or the connecting rod, or both.

**Standard value: 4,900 - 14,700 N**



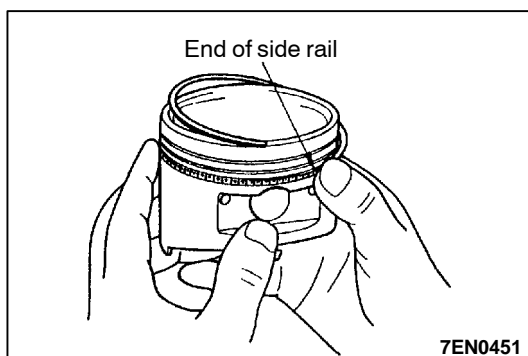
### ▶B◀ OIL RING INSTALLATION

- (1) Fit the oil ring spacer into the piston ring groove. Then, fit the upper and lower side rails.

#### NOTE

- (1) The spacer and side rails may be fitted in either direction. No distinction is made between top and bottom.
- (2) Spacer and side rail sizes are color-coded as follows:

Size	Color
STD	None
0.50 mm O. S.	Blue
1.00 mm O. S.	Yellow

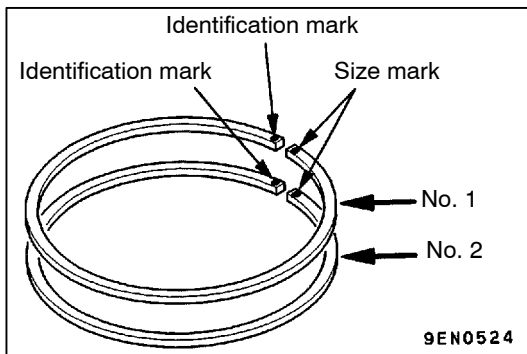
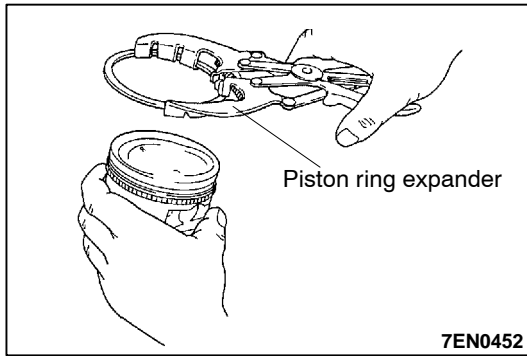


- (2) To install a side rail, fit one end of the rail into the groove then press the rest of the rail into position by hand as shown.

#### Caution

**Do not fit side rails using a piston ring expander since they may break.**

- (3) After installing the side rails, check that they move smoothly in both directions.



### ►C◄ PISTON RING No. 2 / PISTON RING No. 1 INSTALLATION

- (1) Using piston ring expander, fit No. 2 and No. 1 piston ring into position.

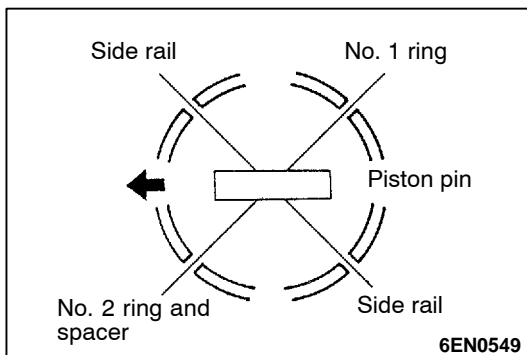
#### NOTE

1. The ring end is provided with identification mark.

Item		Identification mark
No. 1 ring	With catalytic converter	1T
	Without catalytic converter	T
No. 2 ring	With catalytic converter	2T
	Without catalytic converter	T2

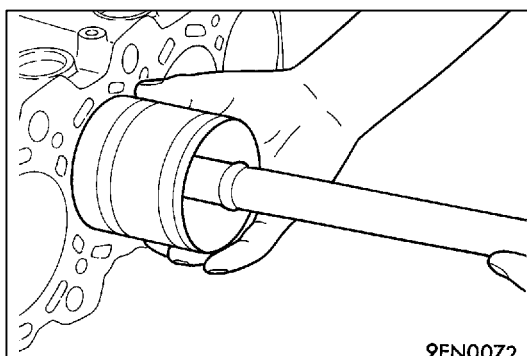
2. Install piston rings with identification mark facing up, to the piston crown side.
3. Size marks on piston rings are as follows.

Size	Size mark	
STD	None	ALL
0.25 mm O. S.	25	4G18
0.50 mm O. S.	50	ALL
1.00 mm O. S.	100	4G13, 4G15



### ►D◄ PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

- (1) Apply oil to the piston, piston rings, and oil ring.
- (2) Align the gaps of the piston rings and oil ring (side rails and spacer) as shown.
- (3) With the piston crown's front arrow mark pointing toward the timing belt side, press the piston and connecting rod assembly into the cylinder from the top of the cylinder.



- (4) Compress the piston rings tightly with a suitable ring compression tool, then press the piston and connecting rod fully into the cylinder. Do not strike the piston hard since the piston rings may break and the crank pin may be nicked.

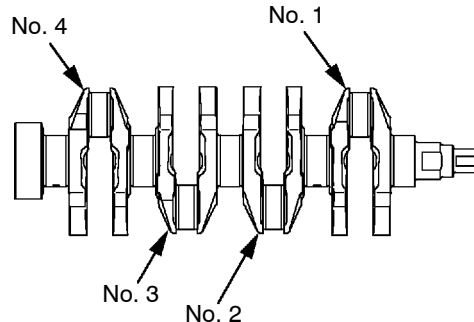
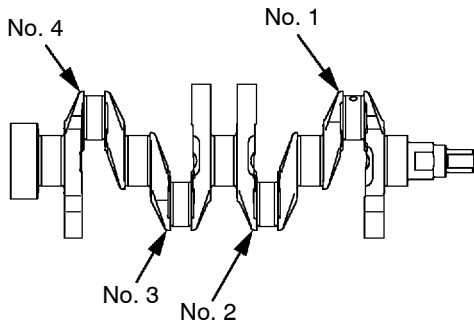


►E◄ CONNECTING ROD BEARING INSTALLATION

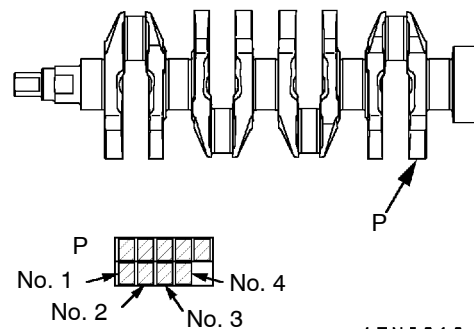
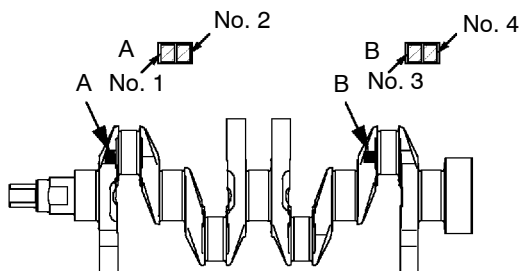
4G13, 4G15

4G18

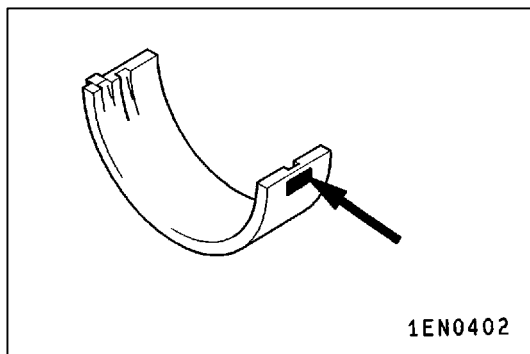
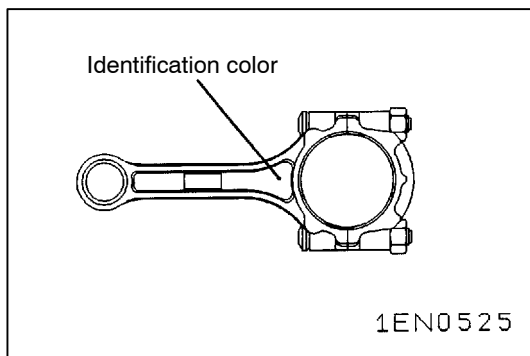
Color code positions



Identification mark positions

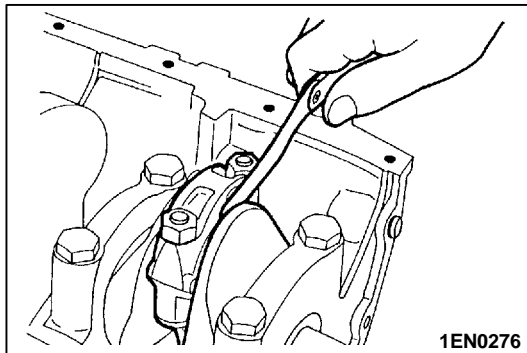
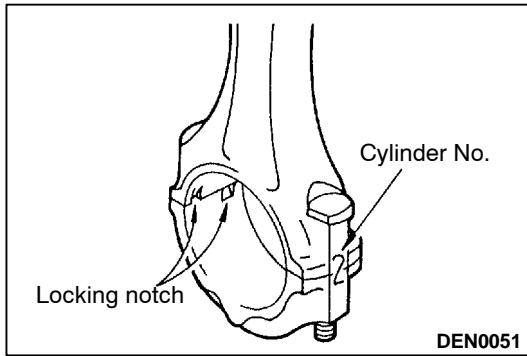


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(1) Select bearings according to crankshaft and connecting rod identification marks or color codes, referring to the following table.

Crankshaft identification mark	Connecting rod identification color	Bearing identification mark
I, Yellow	White	1
	None	1
	Yellow	2
II, None	White	1
	None	2
	Yellow	3
III, White	White	2
	None	3
	Yellow	3



### ►F◄ CONNECTING ROD CAP INSTALLATION

- (1) Aligning the marks made during disassembly, fit the bearing cap onto the connecting rod. If the connecting rod is new and has no index mark, ensure that the bearing locking notches are both on the same side.

- (2) Check that the connecting rod big end side clearance confirms with specifications.

**Standard value: 0.10 - 0.25 mm**

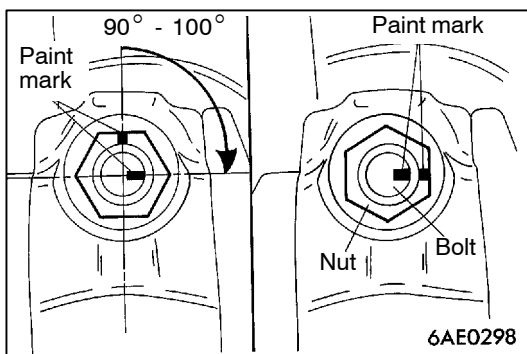
**Limit: 0.4 mm**

### ►G◄ CONNECTING ROD CAP NUT INSTALLATION

#### Caution

To fit the connecting rod cap nuts with the cylinder head in place, the spark plugs must be removed beforehand.

- (1) The connecting rod bolts and nuts utilize the plastic region tightening method. The bolts must therefore be checked for stretching before reuse. To check a bolt for stretching, screw the nut down the entire length of the thread by hand. Unless the nut turns smoothly all the way, the bolt's threaded section is stretched and the bolt must be replaced.




- (2) Before fitting the nuts, apply engine oil to their threads and seating surfaces.
- (3) Fit the nuts onto the bolts and turn them until they are finger-tight. After this, the nuts must be tightened alternately to ensure correct fitting of the cap.
- (4) Tighten the nuts to a torque of 17 Nm.
- (5) Make a paint mark on the top of each nut as shown.
- (6) Make paint marks on the bolts 90 to 100° clockwise from the paint marks on the nuts.
- (7) Turn the nuts until their paint marks are aligned with the paint marks on the bolts.

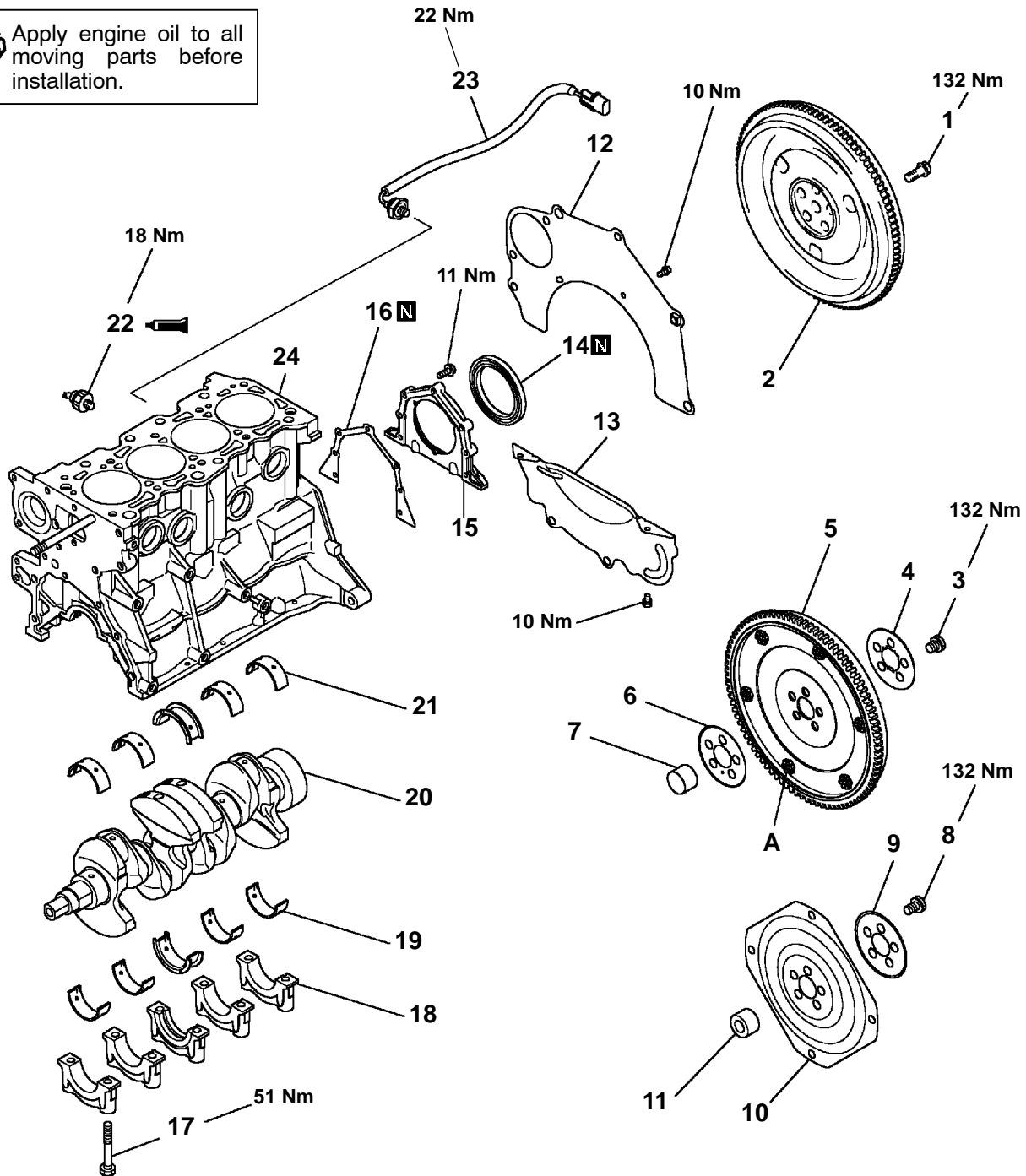
**Caution**

1. If the nuts are turned by less than 90°, the cap may not be held on with sufficient strength.
2. If the nuts are turned by more than 100°, loosen them completely and carry out the tightening procedure again.

# 12. CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION

 Apply engine oil to all moving parts before installation.



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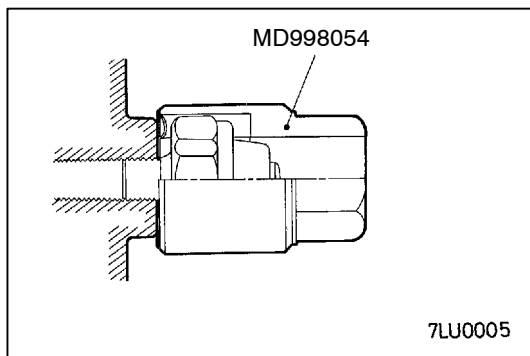
**Removal steps**

- |                        |         |                                    |
|------------------------|---------|------------------------------------|
| 1. Flywheel bolt       |         | ▶D◀ 14. Rear oil seal              |
| 2. Flywheel            |         | 15. Rear oil seal case             |
| 3. Flywheel bolt       |         | 16. Rear oil seal case gasket      |
| 4. Adapter plate       |         | ▶C◀ 17. Bearing cap bolt           |
| 5. Flywheel            |         | ▶C◀ 18. Bearing cap                |
| 6. Adapter plate       |         | ▶B◀ 19. Crankshaft bearing (lower) |
| 7. Crankshaft bushing  |         | 20. Crankshaft                     |
| 8. Drive plate bolt    |         | ▶B◀ 21. Crankshaft bearing (upper) |
| 9. Adapter plate       | ◀A▶ ▶A◀ | 22. Oil pressure switch            |
| 10. Drive plate        |         | 23. Knock sensor                   |
| 11. Crankshaft bushing |         | <4G13, SOHC 16-VALVE>              |
| 12. Rear plate         |         | 24. Cylinder block                 |
| 13. Bell housing cover |         |                                    |

**Caution**

On the flexible flywheel equipped engines, do not remove any of the bolts "A" of the flywheel shown in the illustration.

The balance of the flexible flywheel is adjusted in an assembled condition. Removing the bolt, therefore, can cause the flexible flywheel to be out of balance, giving damage to the flywheel.



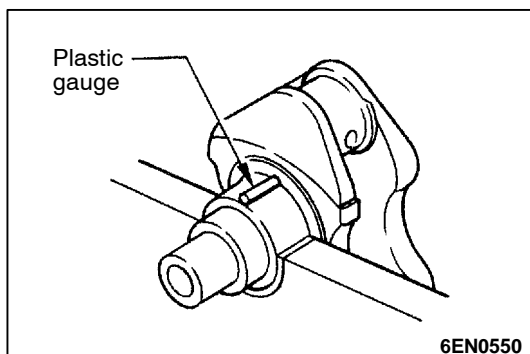
## REMOVAL SERVICE POINTS

### ◀▶ OIL PRESSURE SWITCH REMOVAL

- (1) Disconnect the oil pressure switch terminals.
- (2) Using the special tool, remove the oil pressure switch.

#### Caution

The thread is coated with sealant. Take care not to bend it when removing the oil pressure switch.



## INSPECTION

### 1. CRANKSHAFT OIL CLEARANCE

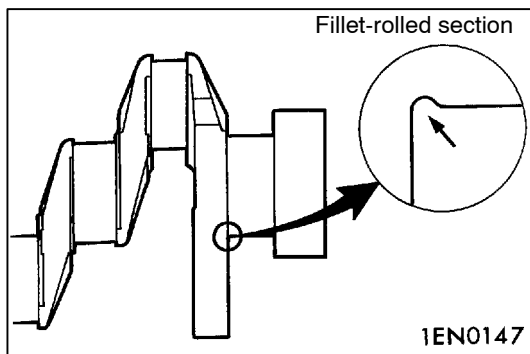
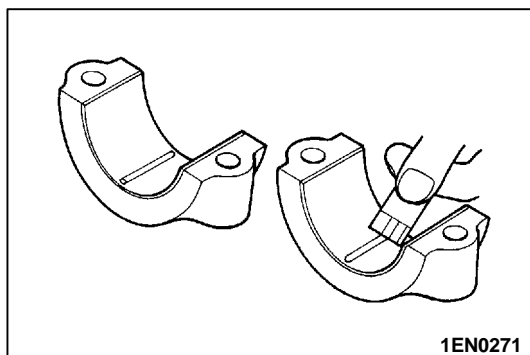
The crankshaft oil clearance can be measured easily using a plastic gauge.

To check the crankshaft oil clearance with a plastic gauge, carry out the following procedure:

- (1) Wipe all oil off the crankshaft journal and the bearing's inside surface.
- (2) Install the crankshaft.
- (3) Cut the plastic gauge such that its length matches the width of the bearing, then place it on the journal along the journal's axis.
- (4) Gently fit the crankshaft bearing cap and tighten the bolts to the specified torque.
- (5) Remove the bolts and gently remove the crankshaft bearing cap.
- (6) Using the scale printed on the plastic gauge bag, measure the plastic gauge's crushed section at its widest point.

**Standard value: 0.02 - 0.04 mm**

**Limit: 0.1 mm**



#### NOTE

The crankshaft pins and journals are fillet-rolled and must not be machined to undersize dimensions.

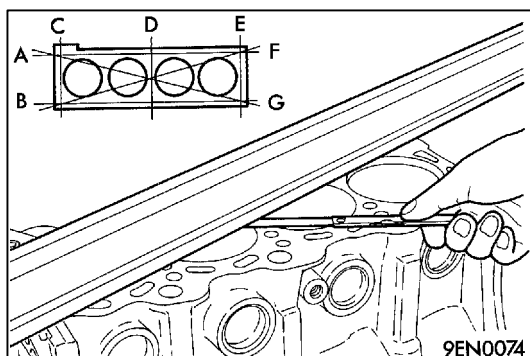
### 2. CYLINDER BLOCK

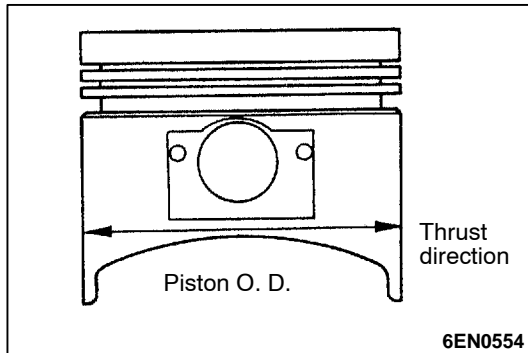
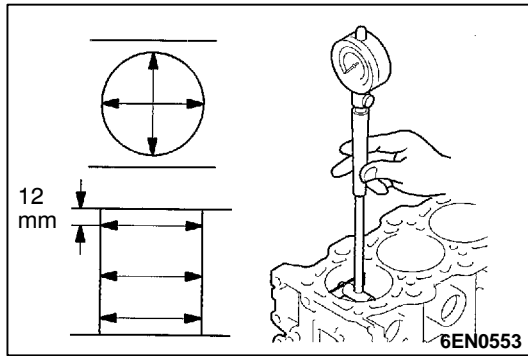
- (1) Visually check for cracks, rust, and corrosion, and inspect the cylinder block using a flaw detecting agent. Rectify defects where possible or replace the cylinder block.
- (2) Ensure that the top surface is free of gasket chips and other foreign material. Check the cylinder block's top surface for distortion using a straight edge and thickness gauge.

**Standard value: 0.05 mm**

**Limit: 0.1 mm**

- (3) Check the cylinder walls for cracks and seizure marks. If defects are evident, bore all the cylinders to oversize or replace the cylinder block.





- (4) Using a cylinder gauge, measure each cylinder's bore and cylindricity. If any cylinder is severely worn, bore all the cylinders to oversize and replace the piston and piston rings accordingly. Take measurements at the points shown.

**Standard value:**

**Cylinder bore:**

4G13 engine: 71.0 mm

4G15 engine: 75.5 mm

4G18 engine: 76.0 mm

**Cylindricity: 0.01 mm or less**

### 3. BORING CYLINDERS

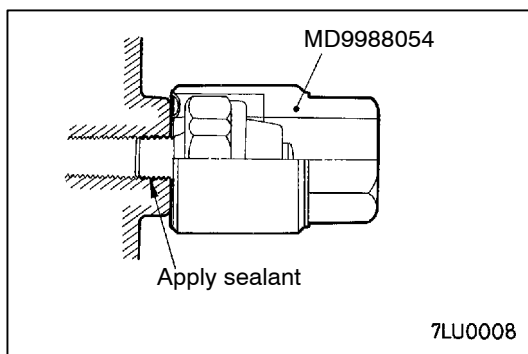
- (1) Oversize pistons to be used should be determined on the basis of the cylinder with the largest bore.
- (2) Oversize pistons are available with the following oversize dimensions: 0.25 mm, 0.50 mm, and 1.00 mm. Measure the diameter of the piston to be used. Boring must be carried out such that the piston-to-cylinder clearance complies with the standard value. The piston's diameter should be measured at the points shown.
- (3) Calculate the boring finish dimension based on the piston diameter dimension.
  - [Boring finish dimension] = [piston O.D.] + [piston-to-cylinder clearance (0.02 – 0.04 mm)] - [honing margin (0.02 mm)]
- (4) Bore each cylinder to the calculated boring finish dimension.

**Caution**

**To prevent distortion caused by heat increases during boring bore the cylinders in the following order: No. 2, No. 4, No. 1, No. 3.**

- (5) Hone the cylinders to the final finish dimension (piston O. D. + piston-to-cylinder clearance).
- (6) Check the clearance between the pistons and cylinders.

**Standard value: 0.02 - 0.04 mm**



### INSTALLATION SERVICE POINTS

#### ▶A◀ OIL PRESSURE SWITCH INSTALLATION

- (1) Apply the specified sealant to the thread, then fit the oil pressure switch using the special tool shown in the illustration.

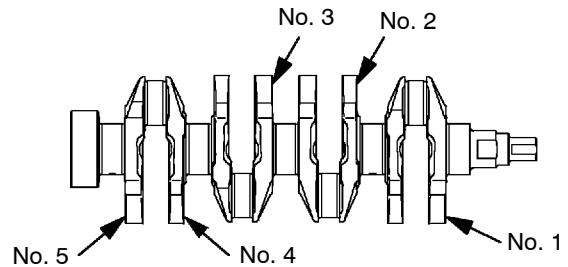
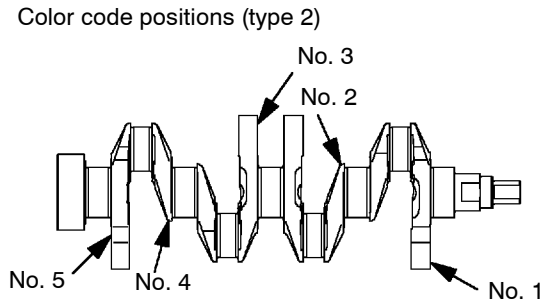
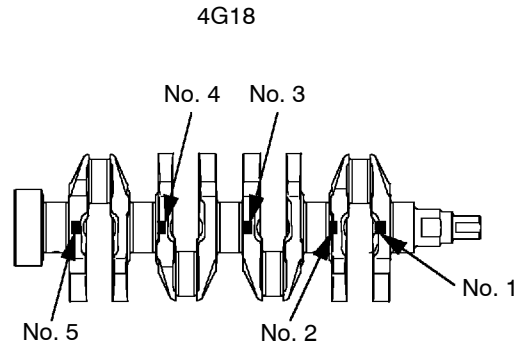
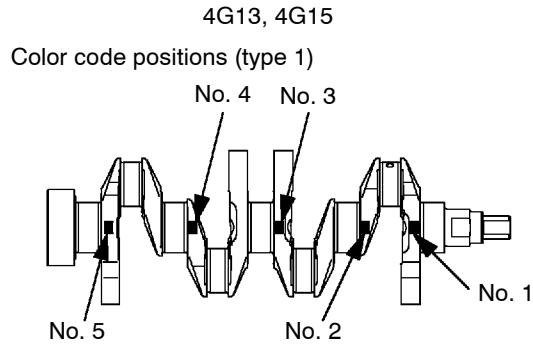
**Specified sealant:**

3M ATD Part No. 8660 or equivalent

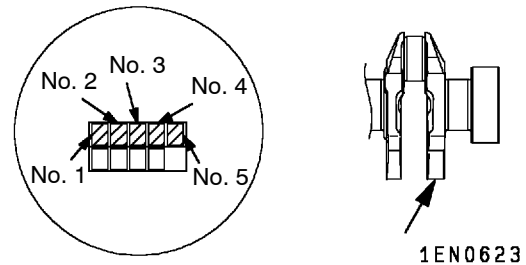
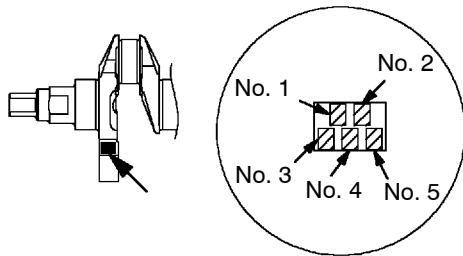
**Caution**

1. Apply sealant such that none is squeezed out past end of the thread.
2. Do not over-tighten the oil pressure switch.

►B◄ CRANKSHAFT BEARING INSTALLATION



Identification mark positions

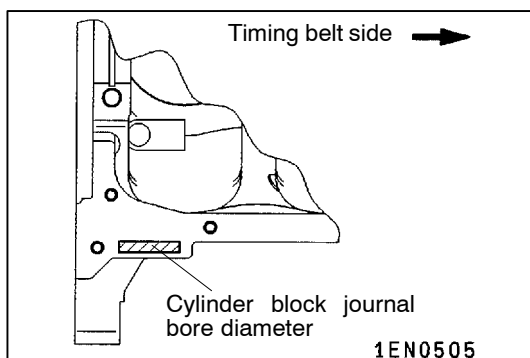


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- (1) Select bearings according to the crankshaft identification marks or color codes, referring to the following table. If they are not identifiable, measure the crankshaft journals and choose bearings to match the measurements.



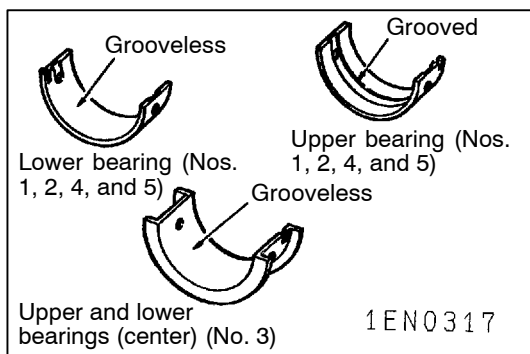
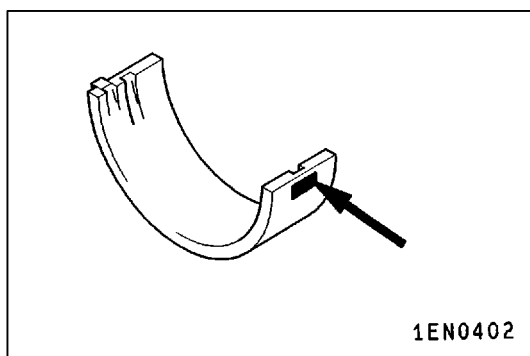
Crankshaft journal				Cylinder block bearing diameter	Bearing
Range	Color code	Identification mark	Journal diameter mm	Identification mark	Identification mark
1	Yellow	1	47.995 - 48.000	0	1
				1	2
				2	3
2	None	2	47.985 - 49.995	0	2
				1	3
				2	4
3	White	3	47.980 - 48.985	0	3
				1	4
				2	5



(2) Identification marks showing the cylinder block bearing bore diameter are stamped in the position shown, with No. 1 at the front of the engine. Bearings must be selected and installed in accordance with these identification marks.

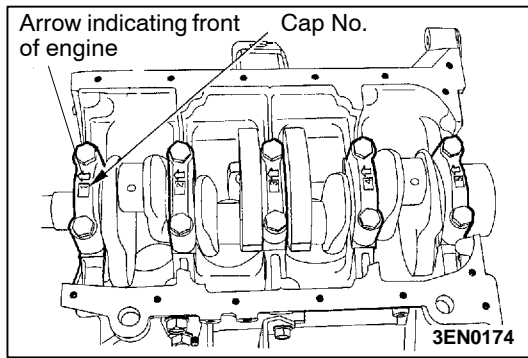
(3) Based on the identification markings verified in steps (1) and (2), select bearings from table above. See the following example:

1. If the measured crankshaft journal diameter is 48.000 mm, this corresponds to classification 1 in the above table.
2. If the identification mark on the cylinder block bearing hole is "1", select a bearing with an identification mark of "2".



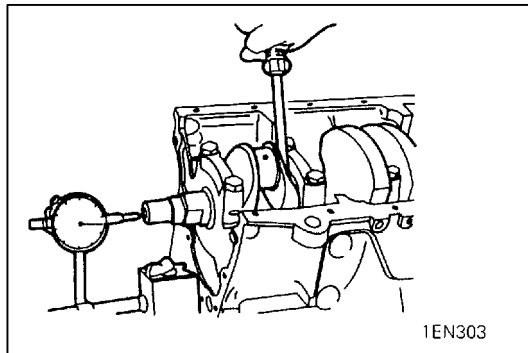
(4) Except for the center bearing, all the upper bearings are grooved. The center bearings are grooveless and have flanges. The center bearings are the same at the top and bottom.

(5) The lower bearings are all grooveless.



### ►◄ BEARING CAP INSTALLATION

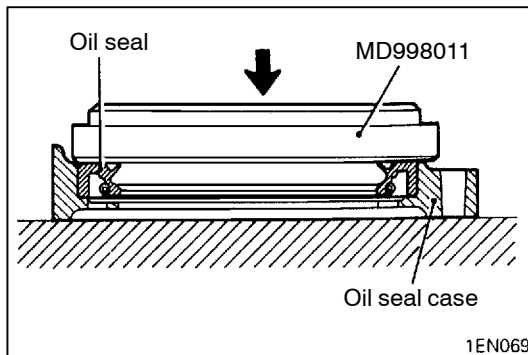
- (1) On the bottom surface of each bearing cap is the cap's number and an arrow. Starting at the timing belt side, fit the bearing caps in numerical order. Ensure that the arrows point toward the timing belt side.



- (2) After fitting the bearing caps, measure the end play in the crankshaft. If the measurement exceeds the specified limit, replace the crankshaft bearings.

**Standard value: 0.05 - 0.18 mm**

**Limit: 0.25 mm**



### ►◄ REAR OIL SEAL INSTALLATION

- (1) Press-fit the rear oil seal using the special tool shown in the illustration.

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## NOTES